THE

MANUFACTURE OF LEATHER:

BEING A

DESCRIPTION OF ALL OF THE PROCESSES FOR THE TANNING, TAWING, CURRYING, FINISHING, AND DYEING OF EVERY KIND OF LEATHER;

INCLUDING THE

VARIOUS RAW MATERIALS AND THE METHODS FOR DETERMINING THEIR VALUES; THE TOOLS, MACHINES, AND ALL DETAILS OF IMPORTANCE CONNECTED WITH AN INTELLIGENT AND PROFITABLE PROSECUTION OF THE ART, WITH SPECIAL REFERENCE TO THE BEST AMERICAN PRACTICE.

TO WHICH ARE ADDED

COMPLETE LISTS OF ALL AMERICAN PATENTS FOR MATERIALS, PROCESSES, TOOLS, AND MACHINES FOR TANNING, CURRYING, ETC.

BY
CHARLES THOMAS DAVIS.

ILLUSTRATED BY THREE HUNDRED AND TWO ENGRAVINGS,

AND

TWELVE SAMPLES OF DYED LEATHERS.

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PREFACE.

Considering the importance of the leather industry, it seems strange that up to the present time it should in technical literature have been so much neglected.

There is not in England nor is there in America a single current book broadly treating all the branches of this subject, and the object of the present volume is fully to explain the details of manufacturing all kinds of leather in common use, and produced from hides and skins by the agency of the usual tanning substances.

The author has not been satisfied to make use of the matter found in obsolete books, but has preferred to present a view of the state of the art as it to-day exists in the United States.

The tools, machines, and in fact nearly all the mechanical appliances illustrated in the present treatise are of American origin, and in common use in the numerous tanneries and leather-finishing shops of the country.

The collection, compilation, and collation of the vast amount of technical and detailed information attainable relating to the various processes, and to the construction of the numerous machines herein described, have required almost herculean labor. But the work has been greatly aided by many of the leading tanners and curriers of the United States, who have not only placed at the author's disposal every opportunity for personal observation, but have promptly and courteously responded to

his letters when containing requests for information. It is doubtful if such facilities as have been extended to him would be granted to a like professional writer on technical subjects in any other country in the world.

The enormous development of American leather manufacturing industries is a source of much congratulation. There are of course in this manufacture, as in all others, times of depression, but the natural facilities for obtaining the raw material, the great ingenuity of our people, and the steady increase in the export demand, added to the large home consumption of leather, are certain to keep the United States in the position of the leading leather-producing country of the world.

The invention and employment of a large number of mechanical appliances have done much to stimulate and cheapen leather production in the times just passed, and those manufacturers who have clung to the old-fashioned methods of tanning and finishing leather by hand have found their business absorbed by more enterprising firms.

Such results were only natural, and it is therefore in the future very desirable that those now in the business should keep fully abreast of the improvements in the art. When a machine or process has, after fair trial and investigation, proved to be an improvement upon old methods, it is simply suicidal to a business not to employ it. Every new method or contrivance is not necessarily an improvement: but the success of small tanners and curriers in the future lies solely in the discriminative adoption of labor-saving machines and time-saving processes.

It is among those who produce leather on a small scale that many chemical experiments in depilating, bating, and tanning could be conducted without serious loss or inconvenience, and it is urgently recommended that in the future more attention be given to this subject than it has received in the past. Every

process or machine used in leather manufacture that has been patented in the United States since 1790 to the close of the year 1883 is mentioned in this work. Ten volumes of the size of the present one would not have been sufficient to describe them all in full, but a printed copy of any patent issued since the year 1866 will, on receipt of twenty-five cents, be sent by the Commissioner of Patents to any address in the postal union. The patents issued prior to 1866 require to be copied in manuscript, and are therefore charged for by the United States Government according to the number of words contained in them. Thus there is by means of the present volume placed at the disposal of any person who desires it, an opportunity to become fully acquainted with every step and improvement in leather manufacture made in the United States during nearly a century.

The author desires to acknowledge the assistance which he has received from Dr. Thomas Antisell, Mr. John P. Chapman, and Prof. Benjamin S. Hedrick, examiners in the United States Patent Office, all of whom have most kindly and willingly aided him in many ways. The numerous and valuable lists of patents contained in this volume could not have been perfected but for the facilities which the above-named gentlemen have extended.

Prof. William H. Seaman, assistant examiner, early manifested his interest in the work, and his suggestions from the first have proved valuable.

Col. Weston Flint, and his assistants in the scientific library of the United States Patent Office, have also greatly aided the author in his researches, and to them also he desires to acknowledge his indebtedness.

To the enterprising publishers of this volume much credit is due. They have most kindly responded to every suggestion of the author, and have coöperated with him in every particular, sparing neither time, labor, nor expense.

The chemistry relating to leather, skin, and tannins has been compiled from the best German and French authorities, and due credit is given for all such matter in the proper places in the volume.

It is earnestly hoped by the undersigned that his long labors will not prove unfruitful, and that many persons will be benefited by his work.

CHARLES T. DAVIS.

1114 Pennsylvania Avenue,
Washington, D. C., Nov. 22, 1884.

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MANUFACTURE OF LEATHER.

PART I.

CHAPTER I.

HIDES AND SKINS—THE VARIETIES OF HIDES AND SKINS USED FOR LEATHER—REMOVING HIDES AND SKINS FROM ANIMALS—SELECTING HIDES AND SKINS—FRAUDULENTLY INCREASING THE WEIGHT OF HIDES—PRESERVING HIDES—LIST OF AMERICAN PATENTS FOR PRESERVING HIDES—COMMERCIAL CLASSIFICATION OF HIDES.

FROM a very early period the hides and skins of animals have been doubtless much employed to contribute, first, to the necessities, next to the comforts, and finally, to the luxuries of man, being easily obtainable and adapted for shelter, apparel, and for a large number of articles of general utility.

The origin of their use is more likely to be traced to mountainous than to low and warm districts, as in the first the animal food was desirable, and warmer clothing more necessary than in the latter, where man originally lived, between the tropics, under wide-spreading and protecting palm-trees, where food came spontaneously from the earth, and clothing was neither used nor requisite, and was not employed until circumstances finally compelled him to gradually migrate towards the poles.

Then, as necessity has always been the mother of invention, mankind acquired sufficient knowledge to select the tender portions of plants and form them into clothing, and when they

reached greater altitudes and colder districts to slaughter animals, using the flesh for food, and the hides for shelter or clothing, and, appreciating the use of plants, agriculture was practised, and for the same reason animals were valued and the breeding of them received much attention.

This branch of industry was carefully cultivated; but, according to the economy of nature, mammiferous animals, as a class, seem destined from earliest times to have preserved a constant equilibrium in the number of animated beings that at all periods have held their existence on the surface of the earth.

The quarrel between Laban and Jacob, in 1739 B. C., gives us an insight into the manner of conducting the cattle business, and the class of animals that were considered profitable.

The same disposition to make contracts and then to seek to break them was just as common then as now. Laban, for a consideration of service, sold to Jacob a certain interest in the sheep and other animals, and then, when he saw that the purchaser was getting the best of the agreement, he changed it, and again he found that he was the sufferer. Jacob was the shrewdest cattle-trader of history, and was more forbearing than is the custom now, as he allowed Laban to change his interest ten times in their dealings before he took his part of the cattle, camels, asses, and other chattels, and departed secretly from the Syrian, turning his back on the East, and his face towards Beersheba, which he had left about twenty-one years previously.

In 1918 B. C., when Abraham and Lot went up out of Egypt into the south, we are told in the thirteenth chapter of Genesis that they were both rich in cattle, in silver, and in gold. After reaching Bethel, because the land was not large enough to contain their vast herds, and also on account of the strife between the herdsmen of their separate cattle, the same as the "cow-boys" of our plains to-day, they divided. Lot journeyed eastward, and chose the watered and rich plains of Jordan, and pitched his tents near Sodom.

Nothing seemingly pleases the herdsmen or "cow-boys" of the present time so much as to be convenient to a wicked city, and doubtless those in Lot's employ were greatly elated at being

so near to Sodom and Gomorrah. Human nature has been the same in all ages; the wicked delight to dwell in iniquity; it is their life, their happiness.

After the departure of Lot the plain of Mamre was selected by Abraham, and the land further than he could see in all directions was his.

In our own day we have great ranches, containing enormous herds of cattle, distributed through Texas, Colorado, New Mexico, Southern California, and other portions of the country; but for extent of territory and number of animals it is not probable that there are any to compare with the possessions of either Abraham or Lot.

From the omission of the census to include the business of the retail slaughtering establishments in its statistics, and from the manner in which the exports of cattle are recorded at the ports of exit, it is not possible to form an accurate estimate and classification of the annual production in this country; but as cattle-breeding is one of our principal industries, it is important to that interest, as well as to that of tanning, that some such record and classification should be made.

In accordance with the universal assent of mankind, the empire of nature has been divided into three kingdoms:—

1. Mineral.
2. Vegetable.
3. Animal.

With each of these we shall have more or less to do; of the first in the preparation and use of mineral tannins, the second of vegetable tannins, and of the third the hides and skins of the mammalia order of animals.

The mineral kingdom comprises all substances which are without those organs necessary to locomotion, and the due performance of the functions of life. They are composed of the accidental aggregation of particles, which, under certain circumstances, take a constant and regular figure, but which are more frequently found without any definite conformation. The vegetable kingdom covers and beautifies the earth with an endless variety of form and color. It consists of bodies organized, but destitute of the power of locomotion. They are nourished by

means of roots; they breathe by means of leaves; and propagate by means of seed, dispensed within certain limits. The animal kingdom consists of sentient beings, that enliven the external parts of the earth. They possess the power of voluntary motion, respire air, and are forced into action by the cravings of hunger or the parching of thirst, by the instincts of animal passion or by pain.

The skins of the most important of the mammalia class of animals, and the alligator of the fish family, are all with which we shall have to do of the six classes into which Linnæus has divided the animal kingdom. The bodies of nearly the whole species of animals belonging to the mammalia class are covered with hair bestowed in proportion to the necessities of the animal and the nature of the climate which it inhabits, and it is chiefly with the removal of this hair and the preparation, or rather the conversion, of the skin into leather that it shall be the object of this book to deal.

There is no way in which to ascertain at what period the art of removing the hair and wool and manufacturing a fabric from them was acquired; but the art was not unknown in the valley of the Tigris and Euphrates before the date to which any of our histories reach, and Goguet plausibly conjectures that the earliest fabrics were felted, not woven. But the distaff and the loom before a great while again revolutionized the manufacture, and we are told that Abraham, in 1913 B. C., five years after parting from Lot, as has been previously mentioned, refused to take anything from the King of Sodom, "from a thread even to a shoe latchet."

It was centuries, however, before the inventions perfected on the plains spread towards and finally reached the scattered tribes of the colder places, and still longer before the sheep with straight hair, bred on the plains of Africa or Mesopotamia, could be acclimated to those colder countries, in which the straight hair was converted into the matted, curly wool which we find to-day on these animals.

During all this time, among these remote tribes, the skins of animals continued to form the dresses or apparel of the people, and necessity taught the method of preparing them in some

manner, and thus the use of skins beyond the limits of higher civilization continued to be general.

Herodotus tells us that the tribes of the Caspian Sea used seal skins for clothing. Strabo speaks of the Massagetæ wearing fur dresses, and both Cæsar and Lactantius mention the reindeer clothing of the German tribes; and, in fact, so general was their use among the less civilized tribes, that the classical authors used the term "skin dressed" as descriptive of the savage.

The barbarians clung to this style of dress, which added to their savage expression of features, and made them terrible to behold. The British Museum contains a marble bust of one of these characters found in Trajan's Forum, Rome, the expression upon the face of which is that of the most repulsive and savage character, and which has probably increased to a much greater degree by these strange garments.

The nature of the preparation with which the skins were treated, in order to secure their preservation, we have no accurate way of ascertaining; but they were subjected to some processes of treatment, in order to prevent their putrefaction.

Goguet has surmised as to the manner of the origin of the art of tanning, and he has made some very ingenious conjectures as to its discovery, based on the method used by the North American Indians, Greenlanders, and Icelanders in the preparation of skins.

Among all these people and tribes, depilation by maceration in water is common, and it may have been suggested, as Fostrooke has stated, by the natural process of depilation or removal of the hair, as in the cases of drowned animals, when maceration is plainly observed.

Advancing civilization gradually superseded the use of hides and skins for the construction of boats and tents, and their use for clothing and other purposes, in a greater portion of the world. Still so great is the continuously increasing employment for the products of hides and skins, that many of the chief industries of the world are supported from these useful and bountiful supplies of nature.

When these materials are intelligently cared for and treated, they become wealth by contributing to the necessities, comforts,

and luxuries of man, who cannot create; but only take that which God has placed at his disposal; and by the labor of the body, or an effort of the mind, impart to it a value, and make it exchangeable, either into money, or convertible into other things which he desires.

If the buffalo or other valuable animal be slaughtered on our own plains, those of South America, or any other portion of the globe, and the hide or other marketable portion be not removed and preserved, then it is simple waste, but this is one of the conditions inseparable from the absence of man, from whom all value comes, and of diversified industries, which admit of a growth of the power of association, and a utilization of what have before been regarded as waste products.

Then again, if the hides or skins of such animals be not properly cured or treated, so as to arrive at the place of marketing in a perfect condition, it is again waste, and the punishment for such lack of intelligence is visited upon the vender by the purchaser in the shape of loss or deduction from the price.

So through each step in the production of leather, from the moment of the slaughtering of the animal, until the finished product reaches the final purchaser, it is the duty of owners, managers, and employés in every branch to preserve the value, and economize at every point, both in the use of best processes and machinery, and in utilizing the offal, for in these days of close competition there is no room in the tanning or currying industries for extravagance.

VARIETIES OF HIDES AND SKINS USED FOR LEATHER.

The varieties of tanned leather are classed as hides, kips, and skins.

The parts of hides are called butts, backs, flanks, etc., and form grades of thickness and quality.

Hides are the skins of the larger animals, such as those of oxen, cows, and horses.

Kips exceed the size of calf-skins, and are the skins of small or yearling cattle. The East Indian kips are exported both

raw and tanned, from Calcutta and Madras, in such large quantities as to form a distinct branch of the leather trade.

SKINS are those of calves, sheep, goats, deer, pigs, seals, and various other kinds of fur-bearing animals, which latter, of course, usually preserve their hair.

To man, mammiferous animals are immediately useful in various ways. The bodies of some afford him food, the skin shoes, and the fleece clothes. Some of them unite with him in participating in the dangers of combat with an enemy, and others assist him in the chase, in exterminating wilder sorts, or banishing them from the haunts of civilization. Many, indeed, are injurious to him; but most of them, in some shape or other, he turns to his service.

Of these there is none more subservient to his purpose than the common ox, of which there is scarcely a part that he has not been able to convert into some useful purpose. Of the horns he makes drinking vessels, knife-handles, combs, and boxes; and when they are softened by means of boiling water, he fashions them into a variety of other things.

Glue is made of the cartilages, gristles, and the finer pieces of the parings and cuttings of the hides.

Their bone is a cheap substitute for ivory, and is employed for the production of bone-black for clarifying sugars, and a carbonaceous substance employed in the manufacture of Prussian blue, also for the production of ammonia, and for fertilizing.

The hair is used in various valuable manufactures; the suet, fat, and tallow are moulded into candles, or used for a variety of other purposes; the tallow for instance is largely used in connection with fish oil for "stuffing" tanned upper-leather, and there are but few steam-engines on land or sea for which tallow is not used as a lubricant in the cylinders, and in addition it proves a valuable item in the American export trade.

Thus is every part of this animal valuable to man, who has spared no pains to bring it to the highest state of perfection.

In proportion to the advancement in improving the breed of cattle, which is now so much practised in Europe and this country, do the hides become less thick and degenerate into thin and spready pelts.

So generally has this improvement been practised in many portions of Great Britain, that the English tanners now make but little effort to obtain butt hides from their home cattle, and look mostly to South America, Spain, and Portugal for the slaughtered butt hides which they use.

The unimproved original stock on our plains will probably supply us with thick hides for a long period yet to come, and with Mexico so conveniently connected with us by railroads, there is no immediate danger of our suffering for the want of butt hides from the improvement of our breeds of cattle.

Cattle-skins form the chief source of supply for tanneries, and it is not necessary here to enumerate the purposes for which they are employed.

Their former uses for shelter, boats, armors, shields, etc., which have been mentioned before, are of course obsolete; but modern demands far more extensive and in accord with our advancing civilization have arisen, and new employments are all the while being discovered.

Besides the domestic hides, large quantities are imported from the East and West Indies and from the Cape, but especially from South America. From the East and West Indies we receive light dried bullock hides, called kips, which possess a greater or smaller value, according to quality and the thickness of the coating with which they are provided upon the flesh side. Dried kip-skins freed from flesh and prepared with arsenic are also brought from Java, the East Indies, and other places.

Hides from Central Africa and the east and west coasts of Africa, as also from China, are used for upper leather.

The conditions of temperature generally prevailing in South American countries, *i. e.*, hot days and comparatively cool nights, seem to impart to the hide of the cattle greater insensibility to sudden changes of temperature.

The different varieties of South American hides are generally known by the name of the port from which they are shipped. The best hides come from Buenos Ayres and Montevideo, both bringing in commerce about the same price.

They differ externally in that the head of the Buenos Ayres hides is trimmed off rounder and the fore part is narrower than

in the Montevideo hides. A third variety, also imported from South America, is known as Rio Grande hides. They are less valuable than the above, being thinner on the neck and more uneven. They differ externally from them in being longer and more curled around the head part.

The animals which roam along the Pampas and Llanos, or great plains, in herds of vast numbers, are, in addition to those owned by the extensive cattle owners or *hateros*, the stock whence the great quantity of hides used is annually derived. They are imported both in the dry state and salted, and produce a quality of leather ranking as has already been stated.

Heavy hides are converted into sole, belt, and harness leather; also into carriage coverings; medium weight hides are much used for upper leather, and the smaller and lighter kinds are made into leather, much used for *skirtings* and for enamelling. That which is used for some kinds of ladies' shoes and for bridle leather undergoes a bleaching process termed *fair finished.*

Calf-skin is a principal material for the manufacture of upper leather for shoes and boots, and is also much used for bookbinding. This leather, notwithstanding its comparative thinness, excels in strength and flexibility, and for this reason brings a comparatively high price.

The German, and especially the Bavarian calf-skins, are much in demand. Dried calf-skins are imported from the East Indies and from South America. Russia exports large quantities to Germany and France.

Sheep-skins are used for a lower grade of bookbinding, for bellows, whips, aprons, women's shoes, cushions and seat covers, linings and bindings of boots and shoes, gloves, leggins of different kinds, and sometimes for trunks.

When tanned in oil, sheep-skins form a good imitation of chamois leather, and at times they have been tanned with sumach and largely used for the imitation of morocco of all kinds; this was especially so during the American civil war. Sheep-skins and split calf-skins are also sometimes employed to manufacture imitation of French kid and other varieties of morocco leather.

Lamb-skins of very young animals, being of even thickness

and possessing a fine and delicate grain, furnish an excellent glove leather.

The various breeds of sheep, on account of the vast numbers in which their skins come into market, and the numerous applications of sheep and lamb-skins, rank next to oxen in value as sources of leather.

The importance of a breed of sheep for the purposes of the tanner is in inverse proportion to its value as a source of wool. The home supply is very extensive, and although they are capable of making only a spongy, weak leather, the uses to which they are devoted are various, and their manufacture gives employment to numerous hands. Tanned with bark they constitute bazils, and are used for making slippers and as bellows leather; but when prepared with alum and salt, or with oil, white leather, much employed for aprons and by druggists, and chamois leather result. Many are split, the upper or grain side being tanned with sumach and dyed, then worked up as *skiver*, *roan*, and *morocco* into pocket-books and hat linings, and the under portion being made into white leather and used very much by the chemist; but it is much the more general practice to reserve lamb-skins for the latter purpose. Sheep-skins are sometimes tanned with the wool adhering to them and made into mats. In Asia Minor a considerable trade rises from the preparation of lamb-skins for ladies' glove leather, for lining of morning gowns, for slippers, and for winter gloves. On the hides from Asia Minor the wool is kept for the purpose of retaining the warmth. Considerable difference may be observed in the quality of lamb-skins; those from the animals killed shortly after being born are possessed of an exceedingly fine grain, and take a uniform dye. The same qualities are in a great measure retained by the skins till a month old, but from this period they begin to deteriorate. In the southern part of France and in Italy great numbers of lambs are killed averaging four weeks old, and the leather is prepared and employed as a substitute for kid leather.

Goat-skins rank next in order of importance, the products which they yield being beautiful in texture, of great value, and of varied usefulness. Goat-skins are obtained mostly from the East Indies, the Cape, North Africa, South America, Mexico,

Asia Minor, and the hilly regions of Europe, and form the most desirable material for gloves and morocco leather, and are extensively manufactured into blackened "grain leather" for uppers of ladies' shoes. Besides Swiss goat-skins, which are in special demand on account of their smooth grain, those from Mexico are also especially distinguished by their size and strength, being superior in this respect to those of the East Indies.

Horse-hides and the skins of the other *Equidæ*—the ass, zebra, quagga, etc.—have in modern times become very important raw materials for leather. These hides are sometimes used as a substitute for those of cattle, and persons who are not acquainted with leathers probably unsuspectingly purchase articles made from this material.

Boot-makers, of late, sometimes in large cities, make a specialty of producing custom-made stock from this material, they so advertise it, and do not fail to find customers; in fact, there are now a large number of gentlemen who much prefer it, and will accept nothing else.

A large quantity of this material is imported from England, and, when it is intelligently tanned, the boots into which it is made are quite waterproof, easy to the feet, and in many ways very desirable; but when imperfectly tanned it burns and blisters the feet. The chief consumption is, however, as cordovan or enamelled leather, the hides being split by machinery to reduce them to the adapted thinness. Horse-hides are likewise made into tawed, white, or alum leather, and are in this state used as aprons for certain classes of mechanics, and as thongs for the manufacture of common kinds of whips, and for sewing common harness, and also as a covering for base-balls.

Leather made from horse-hides is also sometimes very desirable and useful for the manufacture of horse-collars, but for this purpose also the tanning should be intelligently done, otherwise it will form galls and blisters on the necks of the animals wearing them.

Seal-skins obtained from Alaska and other Arctic regions are of great value for fur, and deprived of it, form a tough but porous leather, and "blacked on the grain," it has, of late, been used for the manufacture of light summer shoes. Common seal-

skins are partly tanned with the hair, and used in that state for the manufacture of travelling bags, caps, aprons, etc.

Hog-skins are of value to the tanner for the purposes only of making saddle leather, but travelling bags, portfolios, etc., are sometimes made from these skins.

Dog-skin is thin, tough, and valuable, and is good for the purposes of making gloves or for *whang*.

Porpoise-skin works into a soft, strong, and very durable leather, and is largely used as ties for gentlemen's heavy shoes.

Hippopotamus and Elephant hides yield a leather of great thickness, when tanned resembling a board, and are used for buffing wheels in cutlery manufacture, and in the construction of implements used for beetling in bleaching and washing cotton and woollen goods.

Alligator-skins have for nearly thirty years been tanned into leather, and have formed an item in the trade lists of this country, and the leather is now being much sought after in European markets.

The industry was first started about 1855, and centred first at New Orleans, the raw skins being obtained from the rivers of Louisiana; but at the present time the skins are principally obtained in Florida, and the tanning of them is quite a large and growing industry of Jacksonville.

Some of the tanneries of Brooklyn, N. Y., make a specialty of these skins; they also form an item in the stock of some of the tanneries in the State of Massachusetts.

The young animals only yield the skins for leather-making, and the portions used are the belly and flanks, the back which forms about one-third the skin is cut out, and the remaining portions are "green salted," great care being observed not to rot the tender portions between the scales. These skins are exported in large quantities to England, and are not uncommonly tanned there.

Alligator-skins form a leather which has a scaly surface, and it is largely employed for fancy boots, shoes and slippers, and it is also much used for making pocket-books, hand-bags, and sometimes large travelling satchels, cigar-cases, and a great variety of other small articles.

Kangaroo-skins are now largely employed in Australia for the preparation of leather. Wallaby and other marsupials native to that continent are also used.

These skins are both tanned and tawed, the chief tanning agent being the mimosa bark, which is very abundant in Australia.

The leathers which they produce are of an excellent quality, strong, and elastic, and are a first-rate rival in appearance to the kid of European tanners; but, owing to the fact that the animals exist only in the wild state, the source of supply is limited and very insecure.

Buffalo-hides are tanned like ox-hides, but they make an inferior quality of sole leather. When tanned in a particular way with oil, they constitute what is termed *buff-belt leather*, which is superior to the similar article made of cow-hides.

Deer-skins are manufactured in large numbers into chamois leather, and also into glove leather.

Shark, and Rhinoceros-skins also find their way into the vat of the tanner, and into a market.

Walrus-hides are tanned in England and employed for main driving belts for machinery.

REMOVING HIDES AND SKINS FROM ANIMALS.

It happens only too often that the hides and skins of slaughtered animals, or of those that have died from natural causes, are not at once taken off, but left for days together on the carcass. This is in the highest degree detrimental to the hides, as they acquire thin and defective spots, through the process of decomposition going on in the carcass, or the worms which are forming in the interior of the animal work destructively upon the hides. Great damage is also caused, although not of so grave a nature, if, in flaying, the work is not done with all due care. The bits of flesh and fat, which are often allowed to remain adhering to hides and skins, become at once decayed and communicate decay to the skin; which is injured or eaten away in spots, becoming, consequently and subsequently, very thin or even worn into holes. Such damage is noticeable in a more especial manner after manufacture, when the leather is found

bad in appearance, or inoculated with dark spots, as is the case with colored leather.

Leaving these defects out of the question, the suppleness and durability of the leather itself will be injuriously affected, if the skins are not suitably and carefully treated in drying and hanging up, by the premature shrinking and imperfect drying of the material.

An evidence that the evils just mentioned, arising from improper treatment, are of more importance than is generally thought, is shown in the fact, that the sheep-skins received in the summer season often yield barely one-third of a material perfectly adapted to the fabrication of imitation morocco leather.

In view of these evils, and in order to promote the interests of the leather trade, the following points are urgently recommended to the producers of the raw material in flaying hides and skins:—

1st. Immediately after the death of the animal the hide or skin should be carefully taken off.

2d. The fleshy or fatty portions still adhering to the skin should be detached down to the smallest pieces.

3d. The hide should, without the least delay, be hung up in a very airy place, one not exposed to dampness, with the hair side inward, so that a draught of air may play upon the entire length of the flesh side of the hide.

4th. In order to prevent the hide from shrinking, the head and tail ends should be stretched out, and nailed to the pole.

5th. The hoofs and legs should be spread with skewers on both sides.

6th. The flaying of the hide should not be intrusted to inexperienced persons; for, unless a certain dexterity is brought into this operation, the value of the skin will be considerably lessened.

Only by observing these directions can skins and hides be properly dried, and delivered free from defects, suitable for valuable use.

The benefits that will accrue to the entire leather trade by following such a course, cannot be rated too highly; for not only will it secure a serviceable material to manufacturers, but

also a large quantity of hides and skins will be saved from destruction, and the market will be better and more fully supplied. A further consequence will also be that a better manufactured article will be produced, and lower prices established for hides.

SELECTING HIDES AND SKINS.

Considerable difference is observed in the thickness and quality of the skins of various animals, even in those of the same class, owing to circumstances connected with the food, age, variety of breed, the state of health, and even the period of the year when they are slaughtered. Thus, large oxen are well known to afford hides which are tanned into thicker and heavier leather than bulls or cows, especially if the latter be old and have had several calves. Bull-hides are coarser-grained, and thinner in the back than those of oxen and heifers, or young cows, but much denser in the neck and parts of the belly. It would also appear that when cows have repeatedly calved, the skin becomes distended and thinner, and does not, therefore, afford as heavy a sole-leather as that of younger animals. Again, hides of animals, dying in a state of disease, are found to be much inferior to those of healthy ones of the same class, although the apparent difference is not very marked before tanning.

No very definite *criteria* are known to guide the purchaser in distinguishing the quality of hides and skins. If the hide be thin, flabby, soft, and will not bear handling, then such a one will not make good leather; but should it present the opposite quality, it may confidently be expected to be a good article. It has been remarked of sheep, that the finer wool varieties have inferior skins; also that the skin gains in thickness and quality considerably in the course of a few days after shearing.

The proper selection of skins, according to size, thickness, and strength, which decide the value of a hide for the preparation of certain varieties of leather, is a difficult problem for the manufacturer, there being not only great differences in the various kinds of hides, but also great inequalities in those of one

species, according to the sex and age of the animal, and the manner in which it had been fed. Many breeds of cattle furnish, for instance, hides possessing a certain thickness towards the sides, while those of others are thinner, or, as the tanner calls it, "fall off toward the sides."

In commerce a distinction is made between hides and skins, as has been stated, though it is not sharply defined, as it depends simply on the thickness of the materials.

In the buying and valuation of hides the following principal points are generally taken into consideration:—

Thin hides, of unequal thickness, are of less value than full and even hides. Young hides are preferable to old ones, as the fibre in the latter is generally thicker and less flexible.

There is besides a difference in favor of the hide of a castrated over an uncastrated animal of the same species.

Hides of animals having died from contagious diseases should be entirely rejected, or at least handled with the greatest care. Many a tanner has suffered severe sickness, or even lost his life, by careless handling of hides derived from animals afflicted with inflammation of the spine. The poisoning, as is well known, is effected by the transmission of a fungus (*Bacterium anthrax*), which, when placed upon abrasions of the skin, produces malignant carbuncles, which in most cases are fatal, if help is not quickly rendered. Besides the *bacterium anthrax*, there are other infectious substances which may produce blood-poisoning.

We will here state that tanneries and other places where skins are stored should be frequently disinfected with a two to three per cent. solution of carbolic acid, and kept as clean as possible. It may also be recommended to the workmen occupied in these places to use the same solution of carbolic acid as a wash against infection.

Independent of the dangerous properties, disinfection and thorough cleansing of the storerooms would expel the foul odors produced by products of decomposition and putrefaction, prevalent in so many tanneries, and contribute materially to the preservation of the hides.

FRAUDULENTLY INCREASING THE WEIGHT OF HIDES BY THE EMPLOYMENT OF SULPHURIC ACID.

It is well known that leather "plumped" by the agency of sulphuric acid is not only brittle, but readily absorbs moisture, and sometimes butchers profit by this property in the sulphuric acid of facilitating the absorption of water by the skin; thus, before delivering the hide they steep it for a few hours in a very weak solution of this acid; the hide looks well and its weight is increased, notably by the amount of water absorbed. This fraud is generally discovered at the "plumping" only, when the hide, having been previously swollen, does not increase in thickness, and especially after the tanning, when it is found that the yield of the leather is in this case by far inferior to the quantity which might have been expected, according to the original weight of the hide. A cabbage leaf, or a piece of blue litmus paper is sufficient to detect this fraud; when applied to the hide the paper takes the tint of onion-peel, so well known. It is true that the hide which has not been tampered with, has also an acid reaction, due, probably, to the small quantity of lactic acid which is found in almost all fleshy parts. But in this second case, the leaf, or the litmus paper becomes only of a very weak, vinous color. The taste of the hide is also a sure indication. By also steeping a piece of the hide in distilled water, to which is then added some chloride of barium, we obtain, if there is fraud, a notable precipitate of sulphate of baryta; with the natural skin a very faint suspicion only is obtained.

PRESERVING HIDES.

Mode of Salting.

Delane's method, which is that generally employed, consists in laying the hides open upon the ground and sprinkling the flesh side with salt, more liberally at the edges and on the spinal portions than on any other parts. They are then folded or doubled lengthways down the centre. The remaining folds are made over each other, commencing with the shanks, then the

peak of the belly upon the back, afterwards the head upon the tail part, and tail part upon the head, and, lastly, by doubling the whole with a final fold, and forming a square of one or two feet. This being done, they are then piled three and three together and left until the salt has dissolved and penetrated their tissue, which generally requires three or four days. Thus prepared they are sent to market.

Skins may be dried even after having been salted by stretching them upon poles with the flesh side uppermost and exposing them to dry air in a shady place.

Ten pounds of salt in summer and somewhat less in winter are requisite for each skin of ordinary size.

In place of salt, disodium sulphate (Glauber's salt) has been recently recommended as having the advantage of not decreasing the green weight and being as good a preservative as common salt, which decreases the weight of the green hides twelve to fourteen per cent. by withdrawing endosmotically water which runs off as solution of common salt, which, by the use of Glauber's salt, is fixed by the formation of crystalline sodium sulphate.

Besides the two materials mentioned, all kinds of antiseptic substances, such as wood vinegar, carbolic acid, mixtures of glycerine and carbolic acid,[1] and recently even salicylic acid, have been proposed and occasionally used for preserving hides, though generally again abandoned for common salt as being the most simple and the cheapest means.

Composition for Impregnating Hides and Skins and Preserving them in such condition as to be capable of being unhaired at any subsequent time by a simple immersion in water.

This is a compound patented by Moret, who claims that it enables hides and skins to be preserved for transport or storage

[1] We will here briefly mention a proposal according to which the flesh side of the green skin is coated with a mixture of 90 parts of crude dark glycerine and 10 parts of 50 per cent. carbolic acid applied with a whitewash brush, after which the skins are packed in boxes and packages. When the skins are to be worked they are freed from the preservative by washing, and then treated in the same manner as green skins. (Der Gerber, 1876, 527, and Wagner's Jahresberichte, 1877, S. 984.)

in such condition that while the hair remains firm until it is desired to remove it, the hides and skins may be immediately unhaired at any subsequent time by a simple steeping in water; that is to say, they are impregnated with the depilatory agent and with a suitable preservative, so that, while protected by the latter from dry-cracking or putrefaction and from the attacks of insects, the former, being already contained in the pores of the skin or hide, is brought into such intimate contact with the hair follicles or glands as to act with immediate effect thereon as soon as the hide or skin is plunged into water, loosening the hair and enabling it to be removed with ease.

To prepare the composition for this purpose: First, make a strong solution of American potash, or ordinary caustic potash, and heat to from about 180° to 200° F. Then add (stirring the composition well meanwhile) realgar in powder in the proportion of about two ounces to three and a half ounces for each pound of potash employed. There may also be added quicklime in the proportion of three ounces, five ounces, or seven ounces for each pound of potash, the precise proportions in each case depending on the kind of potash used, and on the manner in which the composition is to be applied or used. The quicklime may, however, be dispensed with altogether when the potash is sufficiently caustic without it, the quicklime being only used when and in such quantities as it may be absolutely required to effect this object. The composition is allowed to settle and the clear liquor is decanted off. This clear liquor is diluted with water until it marks 10° Baumé. Also make separately a solution of American potash in water at from 8° to 15° Baumé, to which add thirty grains (or more) of salicylate of soda or other preservative salt for every hundred weight of the clear liquor above mentioned at 10° Baumé. These solutions are then poured together. The composition thus produced is applied, either with a brush or mop, to the hide or skin, or by immersion, the hides or skins being either left in this state or dried, according as they are to be kept a greater or less length of time. In the dry state it is claimed that they may be kept for an indefinite period, and may be at any subsequent time restored to their original green and natural condition by simply steeping

them for about twelve hours in water, whereupon the hair and scud may be immediately removed with ease without further treatment with chemical agents.

This mode of preservation, it is claimed, renders unnecessary the injurious liming or other treatment for unhairing.

A Liquid for Curing Hides, composed of Pyroligneous Acid, in which are dissolved Aloes and Alum, or their equivalents.

This compound, patented by Rock, is as follows:—

To one gallon of pyroligneous acid, add about one ounce of aloes and two ounces of alum, both finely powdered, mixed, and dissolved in the acid. This liquid being kept in an ordinary tank or vat, the hides are soaked in it for from four to ten hours, then taken out and drained, when, it is claimed, they are ready for shipment.

Hides so cured may also be unhaired without liming or sweating in the sweat-box. By piling them in a room of an ordinary temperature for three or four days, it is claimed, they will shed the hair so perfectly that they may be put into the tan vat directly afterward; but, if sweated in the sweat-box, the over-sweating which would render any other hide useless, it is claimed, will not injure this hide in the slightest degree, owing to the solidification of the fibres, in consequence of the curing.

For upper leather and harness, which tanners sometimes prefer to lime for unhairing, the inventor states that he usually packs the hides with salt, *i.e.*, after the hide is cured and drained; so that there should not be any surplus moisture, he sprinkles the hide lightly with fine salt and then bundles it up. The object of this is that the salt should refrigerate the hide to a certain extent, and thus keep the hair fast.

There are also other ingredients which may be employed with the pyroligneous acid for the purpose of preserving the hides from bugs, worms, etc. For instance, one dram of arsenious acid mixed with one dram of carbonate of potassa, and boiled in about half a pint of water until it is dissolved, and then added to one gallon of pyroligneous acid.

Sulphate of copper, borax, sulphate of iron, and others may

be used; but the inventor states that he has found that the first compound answers every purpose.

Sabathé and Jourdan's Process.

The preserving substance employed in this method is metallic soap insoluble in water, for instance, with the base of zinc, lead, copper, albumen, iron, manganese, or two or more of these soaps mixed together.

Fatty materials such as resins or bitumina chemically combined or merely mixed in various proportions with oxides or metallic salts are also employed.

Napier's Process.

The patentee claims in this process the use of carbolic acid, or of creasote in any form, and either alone or in combination with each other and with other substances, such as a metallic salt, glycerine, etc.

Sacc's Process.

This process has for its object the preservation of green hides by the employment of chromic acid, pure or combined. The hides to be preserved are soaked in a solution composed of 1 part of bicarbonate of potash and 10 parts of warm water.

The time during which they are soaked in the solution is usually about twenty-four hours, but it may be more or less, according to the temperature of the atmosphere, the thickness of the skins or hides, and their dryness. It is claimed that this simple operation is sufficient for the preservation of the hides or skins. There can be used in connection with bichromate of potash, certain salts, such as those of alumina, zinc or copper, pyroligneous acid, common salt, etc.

Wickersheimer's Process.

This compound for preserving hides is prepared by dissolving in $4\frac{1}{4}$ pints of water over fire, 50 grams of common salt, 10 grams of saltpetre, and 140 to 160 grams of alum, when the solution is allowed to cool; after which dissolve in 200 grams methylalcohol, 20 grams of carbolic acid, then mix this second

solution with the first one and add one gram of thymol. Owing to the preponderance of alum in this solution it needs to be stirred up every time it is used as the alum is apt to settle. The compound is applied with a sponge or brush, or the hides may be dipped into it.

List of all Patents issued by the Government of the United States of America for Preserving Hides, from 1790 *to* 1883 *inclusive.*[1]

No.	Date.	Inventor.	Residence.
58,036	Sept. 11, 1866	E. Sabathé and L. Jourdan,	Paris, France.
59,251	Oct. 30, 1866	H. Napier,	Elizabeth, N. J.
75,794	March 24, 1868	L. S. Robbins,	New York, N. Y.
86,808	Feb. 9, 1869	J. P. Bridge,	Boston, Mass.
112,285	Feb. 28, 1871	A. Rock,	New Orleans, La.
118,746	Sept. 5, 1871	A. Rock,	New Orleans, La.
171,177	Dec. 14, 1875	F. L. C Sacc,	Neufchatel, Switzerland.
246,260	Aug. 23, 1881	J. Wickersheimer,	Berlin, Germany.
281,287	July 17, 1883	J. L. Moret,	Paris, France.

COMMERCIAL CLASSIFICATION OF HIDES.

All hides sold in the American market are classified as dry flint, dry salted, green, green salted, and part cured.

Dry flint is a thoroughly dry hide that has not been salted.

Dry salted is a thoroughly dry hide, having been salted while green.

Green hides are those which are sent in just as they come from the animal after being slaughtered.

[1] The first American patent system was founded by act of April 10, 1790, and it is a source of great regret that no well-preserved history of American inventions dating from that time is in existence, and that no classified list of models which were in the Patent Office at the time of the fire in 1836 can be obtained. The earliest date that can be reached is January 21, 1823, and that is only partially complete. After the fire in 1836, the United States Government advertised for the patents which had been issued prior to the conflagration, and in this way numerous copies of the earlier patents were secured. This explanation is necessary in order to make plain the reason why certain of the numerous lists of patents in this volume contain some patents dating from 1836, and other of the lists contain patents dating from a much earlier period.

Green salted are those that have been salted and are thoroughly cured.

In green salted hides and skins, those which weigh less than 8 pounds are called *deacons;* 8 to 14 pounds, *calf;* and 14 to 25 pounds, if they are plump, *kip;* but if they are thin and poor they are called *runners* or *murrains*, and are sold at two-thirds the price of good kip; all weighing in excess of 25 pounds are called hides.

Green salted hides are understood to be thoroughly cured, free from salt, dirt, meat, water, horns, tail bones, and sinews, and before being weighed all such substances are removed, or a proper reduction is made from the weight.

Part cured hides are those that have been salted, but not sufficiently long to be thoroughly cured.

All stag, tainted, and badly scored, grubby, or murrain hides are called damaged, and must go at two-thirds price, unless they are badly damaged, when they are classed as *glue stock*, and sell at a much lower figure.

When hides are branded a deduction of about ten per cent. is made on all of them.

In dry hides there are other kinds of damaged, such as sunburned, weather-beaten, or moth-eaten.

CHAPTER II.

SYNOPSIS OF THE HISTORY OF TANNING—COMMERCIAL VARIETIES OF LEATHER.

SYNOPSIS OF THE HISTORY OF TANNING.

AN art may continue for a time slowly progressive, but cannot reach its highest point until its limit be precisely defined. An excellent means by which to improve an art consists in explaining its origin and progress and in pointing out the end to be attained, and the bounds within which it must be confined. Without this precaution, we exhaust ourselves in single and unconnected researches, without reference to each other, and the knowledge which we acquire is dissipated and loses in force as it recedes from the common focus.

A small number of principles and a great mass of conclusions; this is the history of all arts, all sciences. The principles must rest upon reliable facts derived from experience and observation; but neither a compiler nor an author can render all conclusions and explanations. The principles are not numerous and are easy of comprehension, but the conclusions arising from them are innumerable, and lucidity is only to be achieved by placing them in order under the general laws to which they respectively belong, and, therefore, a judicious classification is requisite.

We will first give nearer data upon the origin and development of our system of tanning, and subsequently consider minutely and singly each step in the tanning, currying, and finishing of leather, and the different methods and systems in our tanneries at home and abroad, keeping constantly in view the statistics of the foreign leather trade and manufacture as compared with our own. We beg to go back some centuries in history, and we will be convinced that the products of our trade were known in the time of Moses; for at that period leather carpets were already

used in tents; these we may at present still meet with among the Arabs. Colored leather seems to have been common, for Ezekiel speaks of fine red leather, which was probably our splendid red morocco.

In 593 B. C., in describing the brilliant dresses and horse harness of the Babylonians, the Chaldeans, Pekods, Shoas, Koas, and all the Assyrians with them, girded with girdles upon their loins, clothed most gorgeously, all of them captains and rulers, great lords and renowned, riding upon horses, the trappings of which were replete with rich and beautiful colors, Ezekiel conveys some idea of the grandeur which prevailed and the brilliant color of the dyed leather in use at the time he was prophesying the ruin of the two great kingdoms. Leather was also used in the remotest ages by the Israelites as a material to write upon, for they used strips made of leather for this purpose. According to the testimony of Herodotus, the ancient Ionians wrote their annals upon sheep-skin, and the ancient Persians, likewise, according to Diodorus of Sicily.

Herodotus also tells us that the ancient Libyans wore leather clothing; the Ichthyophagists on the banks of the Araxes dressed themselves in seal-skins, and in the time of Alexander the wild inhabitants of Gcodrosia used the hides of animals for clothing and covered their dwellings with leather.

For many years leather was used by the Greeks in the construction of ships; especially by the Phœnicians, who originally inhabited an arid, sandy corner of the earth, between the Red Sea and the Mediterranean, where the soil was not favorable to the growth of timber, and they were obliged to supply its place by covering their boats, constructed of willows woven together, with leather or hides, which even thus early were subjected to a certain amount of dressing. The ancient Germans, also, who lived on the sea-coast, and the original Britons, equally possessed this custom.

Homer praises the splendid half boots of Agamemnon, and Hesiod recommends leather shoes lined with fur.

Homer has perpetuated the name of a tanner who showed kindness to the beggar poet, and now after passing undying through the ages gone, we are charmed by his lines to-day, which

are in praise of his friend, and of good cheer for the working-men who were employed in the tannery which he so frequently visited, and where he was at all times well received.

That the preparation or tanning of hides was discovered centuries ago, and that the leather produced was employed for the same purpose as at present, is shown by the following old proverb, which is a proof that leather shoes were already worn at that time, viz.: "*We must not steal leather to give away shoes in God's name.*" This refers to the legend of St. Crispin, who stole leather to make shoes out of it for the poor. In the old form of speech, "*To draw from the leather*," signified to draw the sword. In low Saxon the same expression signifies to undress. Whatever may be the facts, it is to be presumed that the most ignorant races of antiquity, whose chief occupation was the chase, possessed the knowledge of giving a certain preparation to the raw animal hides to protect them from decay, and to render their necessary clothing convenient. They were certainly driven to invention by necessity, and thus the origin of the art of tanning was probably the work of accident, like the invention of most of the other arts. To them, consequently, must the invention of the art of tanning leather be ascribed, although it must be conceded that this art owes its proper cultivation and perfection to more recent ages.

Such is the synopsis of the historical origin of our leather trade; but the gradual development and progress of technical tanning have been promoted and assisted by many, and among the most zealous are *MacBride*, *St. Real*, *Proust*, *Hermstadt*, *Vauquelin*, *Chaptal*, *Seguin*, *Desmond*, *Von Meidinger*, *Aikin*, and others. Attempts have been made to discover new methods by which hides and skins could be better tanned, and in a shorter space of time, than by the usual mode of treatment. In the year 1768 MacBride discovered the process of raising with diluted sulphuric acid (1 part acid to 400 parts water).

Later great attention was attracted to the system of quick tanning, discovered in 1795 by Seguin, by which hides and skins were tanned in much less time than formerly. This new process was tested by experts, and found to be partially good and partially deficient. In 1801, Banks discovered the tanning

property of *Terra Japonica* (Catechu). Since that time tannin has been discovered in a great number of plants, which will be enumerated in another chapter.

The English discovered, in the last century, the art of varnishing leather, which was soon after imitated in Germany with complete success.

Ballamy, Von Hildebrandt, Edward, and others introduced the art of preparing water-proof leather.

Science has not done its duty in regard to the improvement of the art of tanning. There have been steps taken in the saving of labor, which are of great importance; but in all the long years that have passed since the union of tannin and gelatine was first demonstrated how little progress we have made! At first it did seem to promise immediate results; but failure has succeeded failure, and the fruit which should have resulted has not fully appeared, and all because of a lack of chemical knowledge.

If the production of tanneries has been increased and the time of their work shortened, it is owing not to the introduction of new principles and to scientific theorizing, but to the use of improved apparatus for facilitating old processes. Take away our bark and hide-mills, improved leaches and vats, handling and stuffing appliances and other improved constructions, our splitting, scouring, boarding, whitening, polishing, pebbling, and other modern mechanical inventions, and our steam-power so economically derived from the use of spent tan for fuel, turn us out of doors to work among the rude contrivances of a century past, and would the result of our labor show an extraordinary gain either in time or quality over that of our predecessors?

The modern appliances, of which American tanners are so justly proud, and in which they lead the world, are certainly ingenious and highly praiseworthy, and having taken a deep interest in all classes of mechanical improvements, that have been perfected by my countrymen, and upheld them before all nations, I would not for one moment be understood as depreciating their importance, or in the least to slight the intelligent enterprise of which they are the offspring.

But it is skill, not force, chemical knowledge, not steam-power, which is principally in the future to accelerate and cheapen the process of tanning; and the sooner the trade acts on this conviction, which every day's experience ought to strengthen, the better. If our present machinery can be superseded by the discovery of more effective and economical methods, it will furnish cause for congratulation and none for mourning. Our inventors must aim to be good chemists as they are already good mechanics.

With the analytical taste of the French and the Germans superadded to their great ingenuity and energy, what results might not be expected from their studies? The field to be explored is a broad one. Long as the art of tanning has been known to the world, not one step in its chemical practice seems to be complete. There is still room for inquiry after tanning materials, and still a doubt whether tannin, or what is equivalent to tannin, may not be produced in quantity by artificial means.

Especial attention is invited to all the vegetable, mineral, and artificial tannins which are to be hereafter described, not for experiments that have no knowledge of chemistry to direct them, but for those who are willing to acquire a thorough knowledge of any one of the materials themselves, and then supplement it with that of the chemical combinations which it is capable of forming. In this way only can further satisfactory progress be made, or the result of our experiment be of value. The hide itself should be examined and analyzed at every stage of its manufacture. Its structure cannot be too minutely scrutinized; its preliminary preparation is a problem; the nature of gelatine is a study; the manufacture of ooze, simple as it appears, is not uniform; the proper consistency and strength of the liquor are yet to be graduated and fixed. Most of all, the union of the tannin and the gelatine in the interior fibres is to be critically observed and facilitated by every possible means. The object is, of course, to produce leather in less time and at less cost than heretofore.

To these remarks the tanner will probably reply that he has neither taste, time, nor means to employ in chemical experi-

ments. But if this be so, he can at least join his brethren and endeavor with them to effect, by concerted action, that which it may be impossible for a single individual to accomplish. It is worth while to inquire whether our associations might not advantageously employ educated chemists to unlock for them the secrets of nature.

There is no denying that our pathway to success winds up the hill of science. If we cannot travel it alone, we should secure guides, and accept whatever assistance is at hand.

Of late some attention has been given in Europe to a system of tanning or tawing by means of chromium compounds patented by Dr. Christian Heinzerling, a German chemist. The oxidizing power of chromate salts, and the deoxidizing effect of which organic matter has upon these salts, have long been recognized, and the knowledge of this action and counter-action has led to many attempts in the past to use chromates in tanning, but which have proved unsuccessful. It is now strongly claimed that the difficulties have been overcome by Dr. Heinzerling's process, which consists practically in the use of bicarbonate of potash, chloride of potassium, or chloride of sodium, and sulphate of alumina. These are mixed together in one large stock-tank, from which the compound is drawn by means of a system of piping communicating with each pit, the quantity required to make the necessary strength of liquor; this at first, as in tanning with bark, is very weak; but every few days it is systematically strengthened, according to the thickness of the hides being tanned. The amount of chromatic acid ordinarily used amounts to from about $2\frac{1}{2}$ to 5 per cent. of the weight of the leather produced, and as the chromatic acid is not expensive the cost of the leather is greatly reduced.

Light skins, such as sheep-skins and calf-skins, are tanned in less than one week, ox and buffalo hides in about two weeks, and walrus hides, more than two inches in thickness, in six weeks.

After being tanned the hides, which at this stage are of a yellowish tint, like sumach-tanned leather, are dipped in chloride of barium, which converts the soluble chromates on the surface into the insoluble chromate of barium. If any particu-

lar shade of color is desired, it is then put on, and in general the hides are colored like ordinary leather.

After being colored the leather is allowed to get nearly dry, when it is immersed in pure paraffin wax and resin dissolved together in certain proportions. These materials with chloride of potassium, or chloride of sodium, and sulphate of alumina, aid in giving the necessary substance weight, and waterproofing to the leather.

The hides are afterwards dried and brushed clean by suitable machinery, and when so finished the leather in appearance differs but slightly from ordinary leather.

Dr. Heinzerling claims as the meritorious and original features of his process the combined use of chromate compounds and fatty matter.

The stuffing with fat or paraffin of chrome leather, he maintains, in the first place, reduces chromic acid to chrome oxide; and secondly, the oxygen thus liberated in the substance of the hide oxidizes the fatty into acid bodies, which, uniting with the chrome oxide, forms a third insoluble compound mordanted in the fibre of the leather, rendering it at once supple and waterproof.

Leather thus made has been reported by Mr. David Kircaldy, London, as very considerably stronger than the best bark-tanned leather he was able to procure. After steeping samples of it in cold water for six days, it has been found that the total quantity of tanning material extracted amounted to from .014 to .135 per cent., while first-class bark-tanned leather treated in a similar way yielded 6.79 per cent.

By boiling chrome leather in water for one-half hour, the loss ranged from .005 to .054 per cent.

The process seems to offer the means of utilizing classes of hides, such as sheep-skins, and very heavy hides, as those of the walrus, hippopotamus, etc., in a way that has not heretofore been found practicable by other processes.

Sheep-skins in chrome tanning do not require to be pured and freed from their oleaginous constituents, and when finished by this process are no longer porous, but waterproof.

They can be shaved and whitened like calf-skins, and it is claimed that they may be used for shoe purposes.

Dr. Heinzerling's process is at work in various localities throughout Germany. For the United Kingdom and British colonies the patent rights have been acquired by the Eglinton Chemical Company of Glasgow, who, as manufacturers of bichromate of potash, have an indirect interest in the general development of the system.

Although the method has not yet fully passed the critical stages of practical experiment, the products appear to be gaining the favor of men of great experience; and should the system fully meet the expectations of its originator and promoters, it cannot in the end fail to greatly cheapen many useful classes of leather.

Dr. Heinzerling's system will be enlarged upon in the proper chapters of this work, in fact, his own language will be used, and no pains spared to fully describe his whole system of tanning.

COMMERCIAL VARIETIES OF LEATHER.

In the present section all the leathers known to commerce will be enumerated and slightly described, and the methods of their manufacture enlarged upon in the succeeding chapters of the work.

The art of tanning is that by which animal hides and skins are converted into leather, a product possessing certain characteristic properties, being manageable and elastic after drying, as well as imputrescible, differing entirely from those of the original material, and eminently adapting it to the varied and useful purposes for which it is employed.

These properties are of a physical nature, and varying with the kind of hide or skin employed, and the modifications of the process which it undergoes.

Chemically considered, however, leather proper, whatever its kind, while not accurately speaking a chemical combination, is a compound of tannin and gelatine, possessing the all-desirable requisites of durability, pliability, inalterability, insolubility in

water, and great power of resisting the action of chemical re-agents, but of this subject we shall have more to say hereafter.

When mineral or earthy substances are used as the leather-making agents, the result is a compound of gelatine with the base employed, and is more or less indestructible, according to the nature of the material and the circumstances under which the combination takes place.

Tawing embraces the preparation of leather by the action of mineral or fatty substances on hides and skins. The system of tawing is principally applied to thin and light skins of sheep, lambs, kids, and goats; although in former times much leather was tawed for military belts, machine belts, etc.; for most light purposes, however, sumach-tanned or similar leathers are now usually considered to be much more durable, as well as applicable.

By tawing a white, pliant leather is obtained with alum, salt, chromium compounds, fats, etc.

This method was practised by the Romans, for we read in Isidore of *calcei* (shoes) called *allutæ* because the skin was softened with alum, and the Romans derived it from Africa. It appears to have been introduced into Hungary before the twelfth century.

This leather is used principally by glovers and harness-makers. In Hungary, also, not long after the invention of tanning, chamois dressing was invented. In this method neither bark nor alum is employed; the leather is simply dressed by rolling and other powerful operations, first with bran, and subsequently with animal fat (train oil). In order that the fat may the better penetrate, the grain side is cut away with sharp instruments. For this reason chamois leather is rough or velvety on both sides. The Hungarians were, in ancient times, especially celebrated for their white tanned leather, which was imitated in France as long as three hundred years ago. In chamois leather, the most famous is the fine, white, shining French and Dane's leather (made from lamb and goat-skins), from which the so-called kid gloves are made.

The inconvenience of raw hides, and their roughness and hardness preventing their adaptation to the body, awoke reflection; men sought to discover the causes of these defects, as well

as the means of remedying them, and thus arose with a gradual progress towards perfection the art of converting the raw hide into leather and for clothing, which mode of preparation is now called tanning.

With an increase of population and wealth the greater became the demand for the necessities of civilization and luxury, and thus forced and attracted by necessity and gain, many experiments were made with a view to the improvement of tanning, until those excellent inventions were attained which have brought tanning to its present state of development. In these experiments the principal properties of tanned leather were kept in view. Attention was paid to the preparation of the hide so as to render it pliant and more impervious to moisture.

The oldest method of tanning is red or bark tanning, or that in which, in addition to the wooden and iron scraping and rubbing instrument used in the preparation or improvement of the hide or skin, lime-water, and astringent extracts from oak and other kinds of bark, or from other vegetable substances, are employed. It is called red tanning because the tanning substances always contain more or less coloring matter, which dye the leather a more or less reddish color.

The ancient orientals understood the art of preparing not only common leather, but even good, and often finely colored varieties, similar to our Morocco and Cordovan. Persian and Babylonian leather has been celebrated for many centuries back, as has been shown. Such leather was brought from Asia into Europe, first into Turkey, Prussia, and Hungary, and thence later to Germany, Holland, England, France, Spain, etc., and these countries learned subsequently to manufacture leather themselves. In the first centuries of Christianity, the Turks, Russians, and Hungarians were the most celebrated tanners; subsequently England, the Netherlands, and Spain endeavored to equal them.

Among fine leathers of foreign origin, *Cordovan*, *Morocco*, *Shagreen*, and *Russia* leathers have been especially famous. Cordovan, a soft, small-grained, colored leather, had already been prepared by the ancient Orientals. Its name is derived from the Spanish city of Cordova, where it was probably first intro-

duced into Europe, and where, for a long time afterwards, it was chiefly manufactured. It enjoyed a great reputation in the eleventh century, when the most distinguished persons wore shoes of Cordovan leather. The French name for shoemaker, "*Cordonnier*," appears also to be derived from this leather. The best qualities have been made in Constantinople, Smyrna, and Aleppo. The best known German Cordovan is the Bremen variety.

From the gradual improvement of Cordovan was engendered *Morocco*, called also Turkish and Spanish leather, a still handsomer leather than Cordovan. This beautifully colored and brilliant leather has been most excellently manufactured in Morocco, in the Levant, in Asiatic and European Turkey, in Krim Tartary, in Aleppo and Smyrna, and in the Island of Cyprus, and very well also in Russia, Poland, Hungary, and Spain, but especially in England, France, Holland, Switzerland, and Germany (in the latter country at Offenbach on the Main, and Calin, in Wurtemberg).

Morocco leather manufacture has been developed to a great extent in our own country, and with us the leading place for its production is Philadelphia, Pa., Newark, N. J., ranking next; but Wilmington, Del., and Lynn, Mass., are also producing it in large quantities.

In contrast to our advancement in this line of production, the past fifteen years has witnessed the gradual but now complete destruction of not only Morocco, but also chamois leather manufacture in Russia, although in other branches of tanning the value of productions has for the same period increased nearly 250 per cent., and the number of tanneries at the present time is not less than 3800 in Russia. Tanning is one of the most widely spread and best developed of Russian industries, being represented in fifty-nine of the sixty Russian governments, and working up in 1879 more than 7,000,000 hides (43,000 poods) and 741,000 goat and lamb skins, the latter being dressed more largely in the governments of Valadimir, Odessa, Vologda, and Kasan.

Russia's wealth in fur-bearing animals, together with climatic conditions, rendering furs a matter of necessity, have given the

trade of dressing these skins a development beyond that of other countries, and it is very much to be regretted that the branch of furriers proper had not been included in the statistics.

Shagreen (in Turkish, *Sagri*, and Persian, *Sagre*) is chiefly celebrated for its hardness and strength, and for the peculiarity of the grain side, which appears as if covered with globular granules; it is also of eastern origin. The best shagreen has been made in Persia, Constantinople, Algiers, and Tripoli. The production of the small globular granules on the grain side was for a long time kept secret. We were first informed many years since by the celebrated traveller, Pallas, that they were produced by stamping the hard seeds of the *wild orach* (*Chenopodium album*) into the hide, spread on the ground; the seeds were afterwards knocked out and the hide scraped on the indented side and soaked in water for two days, in order to raise bulbs where the indentations existed. There is another description of shagreen totally different, made from fish skin, called *fish-skin shagreen;* it is used for covers, wood polishing, etc.

Russia leather is a strong and pliant leather, generally red or black, with a peculiarly penetrating odor, owing to the peculiar smell of oil of birch, and was undoubtedly invented by the ancient Bulgarians. It is only within comparatively late years that we have learned the mode of preparing this leather. Among other things, we first perceived that the peculiar odor arose from the birch oil which was rubbed into the leather. *Inuften*, the German name of this leather, is derived from the Bulgarian word "*Jufti*," a pair, as the Bulgarians, when they colored hides, always sewed them together by pairs in the form of a bag, with the grain side inwards; the coloring liquor was then poured in and the hides kept in motion. The best Russia leather has been made in various Russian and Lithuanian provinces.

But so rapidly has our own country developed the production of Russia leather that we are manufacturing about all the leather of this kind which we consume, Philadelphia and Newark being with us the chief places for its manufacture.

Russia leather was formerly much employed in this country for bookbinding; but its use for this purpose has been abandoned by our principal librarians, and its place superseded by

red-colored Morocco for this purpose. The Russia leather bindings on the books would decay, and finally possess no greater strength than so much common brown paper. In the English libraries, the climate being more moist than with us, the use of Russia leather for bookbinding is still continued to a moderate extent, as the destruction is not so rapid as with us.

Hungarian Leather.—The art of dressing leather upon the so-called Hungarian method, was first brought from Senegal, in Africa, and made known to us in the middle of the sixteenth century by one Buscher, the son of a tanner in Paris. At that time leather was common in Hungary, and that dressed there was very highly esteemed. In the year 1584, two German tanners named Lasmagne and Aurand came to Neuchatel in Lorraine, where they worked at their trade; from thence they went to St. Diziers, in Champagne, and finally to Paris, where they prepared very good leather.

In this process mineral salts are substituted for vegetable extracts. The hides are first treated with a mixture of alum and common salt, by which a portion of the sulphate is converted into the chloride of aluminum, the hides being kept supple by an excess of salt.

The fleshing and scraping processes are proceeded with as in the ordinary modes of tanning, but the hair is removed by shearing instead of liming.

The first alum bath usually contains alum 7 pounds, salt $4\frac{1}{2}$ pounds, water 8 gallons, for each hide of 85 pounds weight.

The whole process of the manufacture of Hungarian leather will be described later in a separate chapter.

Parchment was known long before the invention of paper; for sheep and goatskins were used to write upon in the time of Herodotus. The name is derived from the city of Pergamus, in Asia Minor, where it was excellently manufactured. The best parchment is prepared from calfskin, and inferior qualities from sheep, goat, ass, and pig skins. The fine *virgin parchment* is made from the skins of new-born lambs.

Artificial parchment, which was invented in England, consists of linen, cloth, or paper, which is tightly stretched, and then a paste composed of gypsum, white lead, powdered lime, water,

and parchment glue, is laid on with a brush four times; it is then smoothed with pumice-stone, and lastly steeped in a bright oil varnish.

The use of parchment is not extensive; beyond the ordinary purposes it is sometimes used for deeds, for printing, for diplomas, for organ bellows, and for sieves, and in England for sounding boards in stringed musical instruments. In Germany it is principally manufactured at Bentheim and Schuttorf in Hanover, and also in Augsburg, Nuremberg, Breslau, and Dantzic. Holland, England, and France manufacture excellent parchment.

Alum leather is produced by tanning or tawing the skins white by a solution of alum or salt, and it is the same leather which has been before mentioned as Hungarian leather.

Bazil is sheep-skin dyed with bark and used for making slippers.

Buff leather is so named from the *buffe* or wild bull of Poland and Hungary; it was used for armor, and tanned soft and white, and in Europe it is yet used for sabre belts and cartridge boxes.

Chamois, shammy, or shamoy leather was originally prepared from the skin of the *chamois*, but the skins of other goats, and even of sheep, are now dressed in the soft manner, and furnish skins for carriages, polishing, for gloves, and other purposes.

Enamelled leather is leather split to the required thickness, and then subjected to two operations; the first to render it impermeable to the varnish, and the other to coat it with varnish. The hides used are those of kip, calf, ox, or horse, and are rubbed on the grain or flesh side with three coatings of boiled linseed oil mixed with ochre or ground chalk, and dried after coating. The surface is then pumiced, treated with the same material of a thinner quality in several applications. Successive layers of boiled linseed oil, and of this oil mixed with lampblack and turpentine spread on with a brush, are laid over the thus prepared surface. The surface which has become black and shining, is varnished with copal and linseed oil containing coloring matter, which will be explained at length in the chapter on patent and enamelled leathers.

The leather is curried expressly for this purpose, and particu-

lar attention is observed to keep it as free from grease as possible. It is sometimes used for boots and shoes, but most largely for carriage upholstery and similar purposes. It was first manufactured for carriage tops by David Crockett, of Newark, N. J. Previous to this, oil-dressed leather, presenting the appearance of harness leather, was used for this purpose.

Fair leather is subjected to a bleaching process and is then finished in the color imparted by the bark, and is not specifically colored.

Juncten is a name by which Russia leather is sometimes called.

Japanned, patent, and *varnished* leathers are usually the same as enamelled leather, and the first made in this country was in 1818, by Seth Boyden, of Newark, N. J.

Oil leather is curried in oil, the usual medium being fish-oil, with or without potassa, which is employed in alternation with drying. Fulling, graining, and pummelling are employed, followed by coloring, stretching, and surfacing.

Roan is a leather made from sheep-skins in imitation of Morocco, except the grain, and is used for bookbinding.

Russet is leather finished except the coloring and polishing, the tanned hides being stored in this condition in order to be completed in any desired manner, as the future demand may suggest.

Saffian leather derives its name from Saffi or Asfee, as it is called by the natives properly, and anciently Soffia, which is a city of great antiquity belonging to the province of Abda, and was built by the Carthagenians near Cape Cantin.

This leather is produced from goat-skins, and is but a subname for Morocco. Another leather made near Saffi, in Morocco, is the *Mogador* leather, which is also a sub-name for Morocco leather, and derives its name from Mogador the capital of the fertile Moorish province of Haba. Large quantities of goat-skins are exported from Mogador, which are mostly brought there by caravans from Timbuctoo and the Soudan. Quite a large amount of Morocco leather is produced at Mogador, chiefly of that rich yellow color of which slippers are so universally made.

Skiver is a thin split of leather used for hat linings, sales-cases for jewelry, etc.

Split-leather is that which has been split in a machine for separating the grain from the flesh side.

Sometimes it is done to lighten a leather, and at other times to make two thicknesses, both of which are utilized.

Wash-leather is a skin soft-dressed and suitable for polishing, and for making specie-bags, pantaloon and overcoat pockets, also for cleaning metals, plate, and highly-polished articles.

Whang is a tough leather made from the skins of calves, dogs, ground-hogs, etc., and is used for bag-strings, whip-crackers, belt lacings for machinery, and other occasional purposes.

White-leather is the same as *tawed-leather;* the process leaving the leather white, differing thus from that tanned by ooze.

In commerce the following names are applied to leather:—

Alligator-leather.
Alum-leather.
American-leather.
Backs.
Band-leather.
Bazil.
Belt-leather.
Bindings.
Bridle-leather.
Bronze-leather.
Buckskin-leather.
Buffalo.
Buff-leather.
Butts.
Calf-skin.
Card-leather.
Chamois-leather.
Collar-leather.
Cordovan-leather.
Curried-leather.
Deer-skin.
Dog-skin.
Dyed-leather.
Embossed-leather.
Enamelled-leather.
Fair-leather.
Flint-leather.
Glove-leather.
Goat-skin.
Grain-leather.
Green-hides.
Harness-leather.
Hides.
Hog-skin.
Hungarian-leather.
Juncten.
Kangaroo-leather.
Kid.
Kip.
Luce-leather.
Lamb-skin.
Legging-leather.
Lime-leather.
Linings.
Morocco-leather.
Maroquin.
Oil-leather.
Pad-leather.

Parchment.	Skirting.
Patent-leather.	Skivers.
Rein-leather.	Sole-leather.
Raw-hides.	Split-leather.
Roan.	Stamped-leather.
Rough-tanned-leather.	Striped-leather.
Russet-leather.	Sweat-leather.
Russia-leather.	Tawed-leather.
Saddle-leather.	Toppings.
Saffian.	Trunk-leather.
Salted-hides.	Upper-leather.
Seal-skin.	Varnished-leather.
Shagreen.	Wash-leather.
Sheep-skin.	Waxed-leather.
Shoe and Boot-leather.	Welt-leather.
Sides.	Whang.
Skins.	White-leather.

Artificial leather is produced by various processes. According to the Bonneville method it is made from leather cuttings, shavings and parings, by reducing while in a dry state to powder, which is then mixed with a solution of India-rubber, with or without a solution of gum-lac, or of marine glue, to a suitable consistency.

When partially dried, which process is effected by straining on wire cloth, or perforated metal, the sheets or slabs of artificial leather are pressed between rollers, and, if required, are ornamented with any suitable designs.

This kind of leather is now largely employed for covering cheap and medium-priced trunks, the squares, diamonds, circles and other ornamentation being impressed upon it in the manner which has been mentioned.

Artificial leather is also made for soles and heels of shoddy shoes by pasting thin skivings together and passing them between rollers.

Messrs. Spill & Co., of Stepney, in 1860, matured the manufacture of a substance which they termed *vegetable leather*, and resembled leather-cloth in being an application of caoutchouc

to a woven ground-work or back; but naphtha also took part in its preparation, and it possessed other peculiarities.

They produced it in pieces 50 yards long by $1\frac{1}{2}$ yards wide, and thereby rendered it applicable to many purposes for which hides or skins of real leather would be too small.

They varied its thickness to any desired degree by changing the number of cemented layers, and many qualities of leather were imitated in it at one-third the cost.

The vegetable leather was much used in making carriage and horse aprons, soldiers' belts, buckets, harness, book-covers, and other articles, a large number of which are now produced from what we call rubber cloth.

The Evans Artificial Leather Co., of Boston, Mass., are producers of various grades and colors of artificial leather, which is employed by boot, shoe, carriage, furniture, pocket-book, suspender, glove, jewelry-box, and trunk manufacturers.

There is not the least room for doubt that in the United States the leather industry ranks second in importance only to agriculture, when the amount of capital and the labor employed in all its branches are considered. It ranks among the leading half dozen human industries in many portions of Europe; but it is doubtful if even in England it holds the same relative position that it does in our own country.

In England the iron, cotton, and woollen interests are so very large, and on the continent of Europe the average consumption of leather among the populations is much less than in the United States.

Among the inhabitants of all other parts of the world besides the United States and British North America, the British islands, eastern and southern Europe and Australia, the production of leather is, comparatively speaking, very small, and that which is produced is of an inferior quality.

The hides and skins exported from the excluded sections form a most important item in the stock from which leather is made in the countries which have been named, and the value of the hides and skins, other than furs imported by this country, for the year ending June 30, 1883, was $27,640,030, as is shown in Chapter III.

CHAPTER III.

STATISTICS OF THE TANNING INTERESTS IN THE UNITED STATES.

THE number of tanneries in the United States, the capital invested, amount of hemlock and oak-bark used, number of hides and skins tanned, and the total value of all products is given in the following table, which is based on the year 1880, and includes the States and Territories. The State possessing the largest number of tanneries being placed first, and the others following, according to their relative number of tanneries.

The table does not include the consumption of cutch, gambier, sumach, or other tannins, excepting oak and hemlock barks, either vegetable or mineral. The imports of foreign materials are shown in the table of imports and exports in this chapter.

It will be noticed that in the table, the State of Pennsylvania is credited with the greatest number of hides tanned, while the State of Massachusetts is credited with tanning the largest number of skins. The reason for the latter being the enormous quantities of goat-skins used in the manufacture of Morocco leather, and sheep-skins consumed for linings, bindings, and skivers.

States and Territories.	Establishments.	Capital.	Hemlock bark.	Oak bark.	Hides.	Skins.	Total value of products.
	No.	Dollars.	Tons.	Tons	Number.	Number.	Dollars.
United States.	3105	50,222,054	1,101,526	353,245	11,773,171	19,936,658	113,348,336
Pennsylvania,	642	15,608,635	379,069	122,550	2,970,680	635,280	27,042,068
New York,	386	11,710,415	334,048	6,624	2,503,855	4,171,290	23,652,366
Ohio,	302	2,022,990	5,775	42,274	456,015	434,732	4,357,273
Virginia,	163	658,973	69	11,661	125,438	30,628	1,011,830
Tennessee,	147	470,075	15	15,085	159,524	66,909	1,504,660
Massachusetts,	133	2,712,130	107,324	74	1,625,344	5,724,897	13,556,721
North Carolina,	133	183,659	29	6,154	83,661	20,750	367,920
Indiana,	105	653,349	1,856	18,633	152,375	57,602	1,266,653
Georgia,	94	143,441	......	30	115	1,561	4,284
West Virginia,	93	515,855	33	16,987	150,317	50,713	1,451,528
Maine,	83	2,459,700	93,406	180	879,160	2,202,158	7,100,967
Alabama,	82	86,876	11	3,591	44,308	15,073	212,545
California,	77	1,746,750	103	22,066	254,624	1,314,215	3,738,723
Wisconsin,	73	1,697,825	36,806	134	327,524	239,581	4,324,433
Michigan,	66	1,081,489	21,139	1,205	184,011	341,793	2,029,653
Kentucky,	63	1,741,430	......	31,107	211,097	213,840	2,511,960
Maryland,	63	802,343	75	24,733	137,617	286,250	1,468,591
New Jersey,	55	1,810,050	11,332	14,675	369,667	1,783,647	6,748,094
New Hampshire,	53	603,450	34,968	......	281,490	404,341	2,315,616
Vermont,	53	433,300	12,264	......	125,232	176,250	1,084,503
Illinois,	34	2,220,114	50,762	137	395,030	1,486,570	5,402,070
Mississippi,	34	37,690	22	1,650	21,020	9,225	106,260
South Carolina,	28	42,675	......	1,605	20,967	4,705	73,597
Texas,	28	31,850	......	825	10,920	9,616	63,750
Missouri,	26	137,850	1,639	3,190	41,419	152,313	435,072
Oregon,	16	36,465	573	240	8,961	5,916	65,767
Utah,	13	43,200	322	81	5,046	4,952	47,267
Connecticut,	11	50,600	472	916	11,950	24,625	146,750
Iowa,	10	14,575	......	108	2,470	12,025	43,974
Louisiana,	10	9,300	......	270	3,412	13,280	28,470
Arkansas,	6	7,683	......	222	2,450	330	12,300
Minnesota,	6	32,450	1,724	......	16,716	7,046	111,000
Rhode Island,	4	368,600	7,375	......	106,777	......	368,000
Colorado,	3	16,700	......	......	4,100	15,100	55,800
Delaware,	3	2,800	......	130	1,400	195	7,000
Idaho,	2	1,850	35	......	400	475	2,216
Kansas,	2	1,167	20	70	980	150	7,452
Washington,	2	14,250	210	......	2,400	900	27,000
Dist. Columbia,	1	9,500	......	30	115	1,561	4,284

From this table, which is based on the census of 1880, it would appear that the average amount of capital invested in each tannery is $16,170, the odd dollars and cents being omitted in this calculation, as well as in the three which immediately follow.

This average is largely exceeded in some portions of the country, the seven States possessing the largest average amount of capital invested in each tannery, rank as follows:—

1.	Illinois	$65,300
2.	New Jersey	52,090
3.	New York	30,340
4.	Maine	29,630
5.	Pennsylvania	24,320
6.	California	22,670
7.	Massachusetts	20,400

The average annual total value of products in each of the tanneries in the United States is $36,500; but this is also largely exceeded in the States which have just been mentioned. The rank of the seven leading States (in the average total value of products) in proportion to the number of tanneries established in each State, is as follows:—

1.	Illinois	$158,580
2.	New Jersey	104,510
3.	Massachusetts	101,930
4.	Maine	85,550
5.	New York	61,010
6.	California	48,420
7.	Pennsylvania	42,100

The business of tanning in this country is profitable (in proportion to the capital invested) in the leading States, in the order in which they will now be named:—

1. Massachusetts.
2. Illinois.
3. Maine.
4. California.
5. New York.
6. New Jersey.
7. Pennsylvania.

The profits should be larger in the State of Massachusetts than in any of the others, the business annually done being about as 5 to 1 to the capital invested; Illinois, Maine, and California about $2\frac{1}{4}$ to 1; New York and New Jersey being scarcely 2 to 1; while Pennsylvania does not average more than $1\frac{3}{4}$ to 1.

Since the census of 1880, a large number of sole leather tanneries have been located in Virginia, Tennessee, and other Southern States, some being to supply the home demand for this variety of leather, and others are entirely devoted to manufacturing leather for export.

The imports and exports of leather should be closely investigated.

For the twelve months ending June 30, 1882, our exports of leather exceeded our imports by $618,403, and for the twelve months ending June 30, 1883, the trade was against us to the amount of $1,811,131. Such changes are too sudden.

There are many places in Europe to which our tanned leather could be exported with profit, but which are neglected. Take, for example, the exports of the United States to Bremen.

In 1878 we exported from the United States to Bremen tanned leather to the value of $149,604, and in 1879 to the value of $234,503, showing a gain of $84,699, which has been increasing each year, but not to the extent which is possible.

The condition of the leather industry of Italy should invite the attention of American manufacturers and dealers to what could easily be made a profitable market for their products.

Although the manufacture of leather is carried on in all the Italian provinces, the product is by no means equal to the wants of the nation, and a large deficiency has annually to be supplied from other countries.

This importation is mainly from France, Great Britain, Germany, and Austria-Hungary, and more recently, to a limited extent, from India.

Leather from the United States has found its way at times, during the past twelve years, into the Italian markets, but in small quantities, and has been principally our hemlock-tanned sole leather, which was re-shipped from Germany.

The number of the tanneries in Italy at the close of 1879 was 1316, divided among sixteen provinces. The tanneries are mostly small, but water and steam power are used in many of them.

The following table shows the importation of raw hides and leather into Italy, from 1869 to 1879, both years inclusive:—

	Raw hides. Quintals.	Leather. Quintals.
1869	129,103	13,188
1870	98,876	10,552
1871	113,743	11,505
1872	127,202	11,705
1873	181,434	11,423
1874	136,761	12,165
1875	141,752	13,535
1876	139,262	16,350
1877	134,987	15,376
1878	106,621	15,719
1879	126,178	15,733

Under the tariff of May, 1878, the duty on importation of sole leather is $4.82, and calf-skins $5.79 per quintal, which is 220.46 pounds.

It was highly desirable that the United States should have been largely represented in Germany at the Leather Exhibition, which commenced June 15, 1881, and continued for three months, at Frankfort-on-the-Main.

In the staple of leather our own country now rivals like manufactures of even England, Germany, and Austria, and no opportunity should be lost to so advertise this fact to all the world.

On account of the cheapness of hemlock bark and other tanning materials in this country, as well as of a generally better class of hides used in the manufacture of leather, our great convenience of position for obtaining the raw materials from South America, the superior labor-saving machinery employed in tanning, and the low rates for freight to Liverpool, there is no reason why our exports of sole and other leathers to Great Britain and the Continent should not be at least twice as large as they now are.

The English tanners have raised all kinds of objections to our leather, they loudly sound extravagant praises of their home products, and let not the slightest opportunity pass to cry down ours; they say that all our leathers are only colored, and are not tanned, that they will not last one-half as long in wear as their home products. When, in fact, our sole and upper leather is of better stock, and will wear one-fourth longer than three-

fourths of that produced in England, even if we do not lime and tan so long.

The following table shows our imports and exports of hides and skins, bark for tanning, cutch and gambir, tallow, fish oils, etc., for the twelve months ending June 30, 1883, as compared to the twelve months ending June 30, 1882:—

			12 months to June 30.	
			1883.	1882.
Imports of hides and skins other than fur .			$27,640,030	$27,841,126
Exports " " " " .			1,220,158	1,449,737
Imports in excess of exports			26,419,872	26,391,389
Imports of leather			8,235,053	
Exports:	1883.	1882.		
Morocco and other fine	$385,825	$687,638		
Leather, sole and upper	6,038,097	7,059,906	6,423,922	7,747,544
Imports in excess of exports in 1883 . . .			1,811,131	
Imports for 12 months to June 30, 1882 . .				7,029,041
Excess of exports over imports to June 30, 1882				618,403
Imports of bark for tanning			343,998	490,588
Exports " "			87,528	97,442
Excess of imports over exports			256,470	393,046
Imports of cutch and gambir			997,536	784,232
Exports of tallow			3,248,749	2,647,515
Imports "			3,399	5,522
Excess of exports over imports			3,245,350	2,641,993
Exports of whale and other fish oils . .			115,490	420,730
Imports " " "			76,553	103,020
Excess of exports over imports . . .			38,837	317,710

At the close of 1880 the number of leather-currying establishments in the United States was 2319, the number of sides of leather curried was 12,464,299, and the number of skins, 10,655,606, and the total value of all curried products was $71,351,297.

Nearly one-third in value of the whole currying business of this country is done in the State of Massachusetts, which exceeds in this line the combined products of New Jersey, Pennsylvania, and New York.

More than nine-tenths of the whole currying business of this country is done in the twelve States which will be shortly enumerated:—

The following table shows the twelve States which have been mentioned, the number of establishments in each, the capital invested, the number of sides of leather and skins curried, and the total value of the products in each State, that having the greatest value of products being placed first; and the others following in relative importance, the table being based on the year 1880.

	Establishments.	Capital.	Sides of leather.	Skins.	Total value of products.
Massachusetts,	194	$4,308,169	4,951,562	5,178,609	23,282,775
New Jersey,	56	1,983,746	818,804	1,703,316	8,727,128
Pennsylvania,	455	2,570,969	1,272,931	404,874	7,852,177
New York,	185	1,720,356	1,048,581	639,772	6,192,002
Wisconsin,	61	1,299,425	734,800	582,451	4,496,729
Ohio,	251	1,089,075	632,615	256,054	3,886,627
Maine,	34	510,900	518,850	232,552	2,612,350
Illinois,	18	537,786	251,660	431,920	2,391,380
New Hampshire,	37	351,850	435,450	339,466	2,161,734
California,	63	427,350	266,054	466,450	2,001,850
Indiana,	93	381,552	276,760	37,181	1,461,776
Michigan,	44	256,311	161,308	63,351	996,932

CHAPTER IV.

EXAMINATION OF LEATHERS.[1]

THE determination of the value and quality of leather by a chemico-technical examination has heretofore been perhaps more neglected than that of any other product of industry and commerce. The consumer or dealer either does not examine the leather at all, but buys his supply from a well-known tannery, or judges it solely by the cut, flexibility, and weight. Although it cannot be denied that an expert may rely on external marks, it must nevertheless be admitted, that these leave us in the dark in many points as regards the value of leather. We need, for instance, refer only to the varying percentage of water in the different varieties, according to the time they have been stored, to prove the importance of a method of testing based upon measure and weight.

Unfortunately no thorough examinations in this direction have thus far been made by competent experts, and the literature in regard to this matter found in chemico-technical works is very meagre. Marquis,[2] who undertook a chemical examination of different varieties of leather, made use of the following process:—

Marquis's Method. 1. *Determination of fat and resin.*—An accurately weighed quantity of leather is cut into small pieces, which are thoroughly dried in an exsiccator, and then three times in succession digested with ether. After distilling off the latter, the matrass, the weight of which has been previously determined, is weighed together with the residue it contains.

[1] Bolley's Technologie, 35 (Bd. vi. 4).

[2] Pharmac. Zeitschr. für Russland, Jahrg. 4, Heft 10, S. 389 ; *cf.* Zeitschr. für analyt. Chemie, 1866, S. 236.

The mixture, consisting of fat and resinous substances, is treated with cold alcohol to separate the resinous constituents from the fat. This method of determining the fat cannot be an accurate one, since, besides fat, other substances, for instance tannic acid, are dissolved by the ether.

2. *Determination of lime in leather.*—6.211 grammes of shredded leather are burned to ashes in a platinum crucible, the ash is treated with hydrochloric acid, the solution filtered, and the filtrate sufficiently washed out with water. The lime is precipitated from the filtrate with ammonium hydrate and ammonium oxalate. The precipitate is washed and dissolved in nitric acid. The oxalic acid in the solution thus obtained is determined by solution of potassium manganate, and the lime calculated from the quantity of potassium manganate used.

Marquis found between 1 and 3 per cent. of lime in the different samples.

3. *Determination of the Tanning Constituents.*—Heinzerling proposes the following method:—

Determination of Water.—10 grammes of sole or upper leather in the form of small cubes are dried in a dry current of air at 170° to 190° F. until a decrease in weight is no longer observed.

It is best to use for this purpose such an air-bath as is shown in Fig. 1. The cubes of leather, contained in a tube expanding in the centre and running to a point in front, are placed in the air-bath and dried.

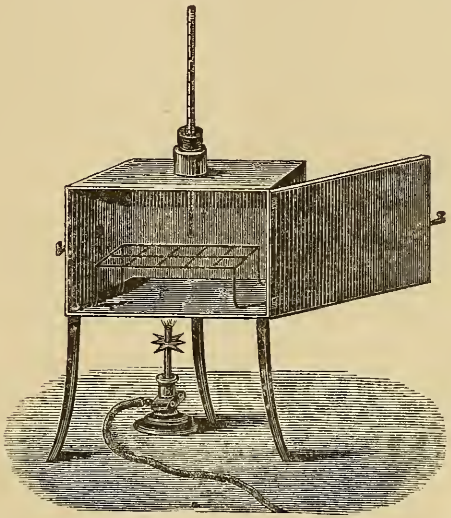
Percentage of Ash.—5 grms. of leather are heated in a porcelain or platinum crucible until all coal is burned. Should this be difficult to effect, some ammonium nitrate is carefully added in order to accelerate the process. The ash is weighed and calculated in the usual manner.

In case the percentage of ash is very high (7 to 10 per cent.), so as to arouse the suspicion of the leather having been made heavy with inorganic substances, the ash is qualitatively tested by the ordinary analytical process and the admixtures, such as chlorides of barium or calcium, which may be found, determined in freshly weighed leather.

As lime in leather exerts an injurious influence upon its

durability, causing, especially, brittleness in upper leather, it is of the utmost importance to learn the percentage of that substance. For this purpose the residue obtained from a determined quantity of leather is dissolved in hydrochloric acid, the solution

Fig. 1.



diluted with distilled water and filtered. The filtrate is boiled with a few drops of nitric acid and compounded with solution of ammonium hydrate and sal-ammoniac to separate the iron and alumina. The lime is precipitated as calcium oxalate with ammonium oxalate, and weighed as calcium carbonate or caustic lime. Members of the fifth group represented in the hydrochloric solution of ash must of course be previously removed.

Percentage of Fat.—As many varieties of leather are excessively greased with fat, in order to increase the weight, it is of interest to determine the percentage of fat. For this purpose 5 to 10 grms. of shredded leather are, according to Caillelet, placed in a small matrass and boiled in a 6 to 8 per cent. solution of soda or potash lye for some time, in order to saponify all animal and vegetable fats. By compounding the soap solution with hydrochloric acid, the free sebacic acids are separated upon the surface of the fluid.

To determine the sebacic acids, they are dissolved in 20 or 30 cubic centimeters of oil of turpentine. The fluid, together with the fat solution, is placed in a graduated tube and by reading the volume of the layer of oil of turpentine containing the sebacic acids in solution, the quantity of the latter is obtained from the increase in volume of the oil of turpentine. If, for instance, 20 c.c. of oil of turpentine have been used and the volume of the solution of oil of turpentine and sebacic acid amounts to 26 c.c. the amount of sebacic acids will, by subtraction, be found to be 6 c.c. The weight of the sebacic acids is obtained by multiplying the cubic centimeters found with the specific gravity.

These methods of determining the fat, although not entirely accurate, are sufficiently so for technical purposes.

Determination of Nitrogen.—As the cleansed leather skin shows a considerable percentage of nitrogen, Müntz has proposed to determine the percentage of nitrogen in leather, in order to draw from it a conclusion in regard to the chemical composition of leather. The method is available for tan-leather as well as mineral-leather.

0.6 to 1 grm. of leather rasped or finely shredded is mixed with a large quantity of soda-lime and placed in a tube of considerable length and the nitrogen determined as ammonium according to the *Barrentrapp-Will* method. As the bubbles of ammonium of a larger molecular weight form also combinations with platinum chlorine, to avoid errors, the platoso-ammonium chloride obtained by precipitation with platinum chloride must not be weighed as such and the nitrogen calculated from it, but the precipitate should be heated in a porcelain crucible and the percentage of nitrogen calculated from the metallic platinum obtained (1 equivalent of platinum = 1 equivalent of nitrogen).

Coriïn, a small quantity of which occurs in the skin, has according to *Reimer*, the formula $C_{30}H_{50}N_{10}O_{15}$ containing consequently 28.3 per cent. of nitrogen. The membranous tissue of which the raw skin chiefly consists, has the formula $C_{15}H_{23}N_5O_6$ and contains 30.3 per cent. of nitrogen. Suppose the skin contains 4 to 6 per cent. of coriïn, the

quantity of nitrogen may be taken in round numbers as amounting to 30 per cent. If, therefore, an analysis should show 15 per cent. of nitrogen in a variety of leather, the latter contains 50 per cent. of skin substance and 50 per cent. of other substances such as water, tanning materials, fats, etc.

Tanning Substance. 1. *Tannic Acid.*—A knowledge of the quantity of tanning material contained in a variety of leather is of more scientific than practical interest. An accurately tested method of establishing the quantity of tannic acid in tan-leather is not yet known. Marquis's method, as already mentioned, has many defects. Other methods require a separation of the tannic acid from the animal fibre, which can scarcely be effected without decomposition of the latter. Mittenzweig's method is the only one worthy of a thorough test.

2. *Mineral Constituents.*—The tanning materials in mineral tanned leather, ferric salt in Knapp's process, and alkaline chromates, chromium salts and aluminium combinations in Heinzerling's, can be readily determined, after destruction of the fibre tissue, by the usual analytical process.

The cutting surface is generally taken as a criterion by which to judge whether leather is thoroughly tanned. It should be uniform throughout the entire mass and show no dark stripes on the sides nor in the centre. The cutting surface of leather not thoroughly tanned presents an unequal appearance, dark stripes occurring on the side as well as in the centre.

The behavior of tan-leather towards boiling water has also been made use of to determine whether the leather has been thoroughly tanned. By heating in water to the boiling point a thin piece of leather not sufficiently tanned, it swells up considerably, and becomes transparent and tough like pig skin, only the thoroughly tanned places remaining opaque and of a coffee-brown color. Such leather, when rubbed between the fingers, is soft and sticky. The decoction obtained from leather insufficiently tanned is generally already turbid on cooling, has a yellow to pale-brown color, and on evaporating the fluid after cooling some gelatine remains behind. Thin strips of thoroughly tanned leather, when boiled in water,

shrink considerably, become opaque and of a coffee-brown color, and brittle when rubbed between the fingers after cooling.

The decoction obtained from thoroughly tanned leather is transparent and of a reddish-brown color and, when evaporated to the consistency of syrup, shows no sign of gelatinizing.

Determination of Means used to Increase the Weight of Leather.—It is frequently the case in modern times, especially in Germany and Great Britain where tanning material is high, that, in order to obtain greater weight, a concentrated solution of barium chloride, aluminium chloride or grape-sugar is not only applied to the flesh side of tanned sole and upper leather, but the entire product is sometimes saturated with it. The detection of these adulterations of leather is not very difficult. Digest the leather in lukewarm water for a few hours, acidulate a part of the resulting aqueous solution with nitric acid and test it with nitrate of silver for chloride, and another part of the solution with sulphuric acid for barium salt. Ammonium hydrate is used as a reagent for aluminium salts.

Precipitates are formed when any of these substances are present. The chloride of silver soon darkens on exposure to light, while the precipitate of alumina produced with ammonium is very voluminous. If only a small degree of turbidity occurs during these reactions, no adulteration has taken place. The detection of grape-sugar is somewhat more difficult, as the tanning material, for instance tannin, passing into solution yields, on splitting, grape-sugar, which must be taken into consideration. The leather is digested in lukewarm water for some time and, in order to precipitate all the tannic acid contained in the solution, some cupric acetate is carefully added. The solution is then filtered and when a precipitate is formed, some Fehling's copper solution is added, and the whole boiled for twelve to fifteen minutes. A strong separation of cuprous oxide is a proof of the leather having been weighted with grape-sugar.

Physical Methods of Testing Leather.

If it is only desired to test the quality of leather, this can be directly ascertained by the following methods:—

I. *Change in Volume and Ability for resisting Water.*—As the ability for resisting water may be considered one of the principal properties of leather, the variety which absorbs water the most slowly and in the least quantity, must evidently be considered as possessing qualities which should testify highly in its favor.

The following table, on page 88, can be understood without further explanation. It was compiled by Dr. Heinzerling, and has been admitted into the present work in order to invite attention to his manner of tanning or rather tawing; hoping that it may eventually be perfected by some of our American inventors into a generally acceptable process, and that whatever objection there may now be to the leather thus economically produced may in the course of time be overcome. The manner of tanning leather by this process will be considered in a subsequent chapter.

Tan Leather.

	Sole leather A.				Sole leather B.				Calf leather C.	
	Weight. Grms.	Increase in per cent.	Thickness. Millimeters.	Increase in per cent.	Weight. Grms.	Increase in per cent.	Thickness. Millimeters.	Increase in per cent.	Weight. Grms.	Increase in per cent.
At the commencement . .	2.43	...	3.45	......	2.40	......	4.25	......	1.5	......
After 35 minutes . . .	3.03	24.7	4.25	23.1	3.50	42.8	4.75	11.7	2.3	53.3
" 16 hours . . .	3.33	37.	4.60	33.3	3.30	34.7	4.6	8.2	2.5	66.6
" 4 days . . .	3.33	37.	4.60	33.3	3.60	46.9	4.7	10.6	2.56	70.6

Heinzerling's Mineral Tanned Leather.

	Sole leather E.				Calf leather F.	
	Weight. Grms.	Increase in per cent.	Thickness. Millime ers.	Increase in per cent.	Weight. Grms.	Increase in per cent.
At the commencement . .	2.66	......	4.75	......	1.50	......
After 35 minutes . . .	2.66	0	4.75	0	1.50	0
" 16 hours . . .	2.83	6.4	5.00	5.2	1.66	10.6
" 4 days . . .	3.21	20.6	5.20	9.5	2.30	53.3

The figures in the table on page 88 show that sole leather tanned in the usual manner absorbs water with the greatest facility, while Heinzerling's leather absorbs none at first, in sixteen hours only 6½ per cent. of its weight, and in four days only 20 per cent.

The tan leather became considerably lixiviated so that the water assumed a dark color, and the sample A did not increase in weight after sixteen hours, while B actually decreased somewhat in weight from the first to the second day. In bending the tan leather after immersion for thirty-five minutes, the water oozed out in drops, while Heinzerling's leather did not show this phenomenon even after four days' immersion, drops of water oozing finally only from the upper leather.

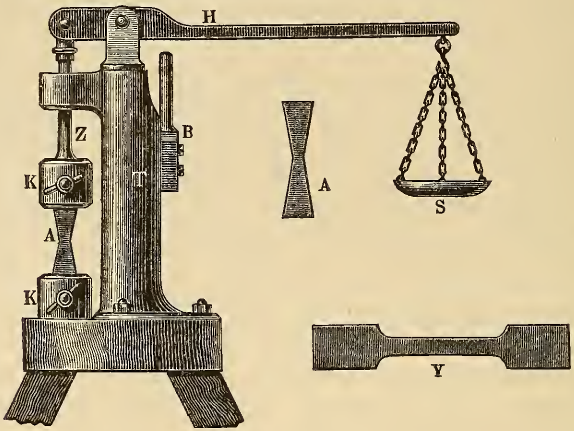
II. *Testing the Strength of Leather.*—The strength of leather can be tested in two directions by determining either its power of resisting tearing or that of breaking. The ability to resist tearing must be especially taken into consideration in varieties of leather intended for machine belts and main braces, while the power of resisting breaking when frequently bent in the same place deserves special attention in leather to be used as upper and sole leather.

Special apparatuses have been constructed to determine the power of resistance against breaking. We will here briefly describe Wiener's apparatus, Fig. 2.

The samples of leather to be tested are best cut with a punch from a determined portion of the side. They receive either the shape of A, or, what is of great importance, if the stretching and remaining elasticity is to be tested at the same time, the shape of Y. In making comparative tests care should be had to use samples of equal thickness. The piece of leather A is stretched in the two clamps K and K. The clamp K is connected with the lever H by means of the drawing-rod Z, which passes through a corresponding aperture in the support T. The long arm of the lever on which hangs the balance S, is to the shorter in the proportion of 100 to 1. In an unweighted state both arms of the lever are in equilibrium. The entire apparatus is fastened to a strong wooden frame. The support B, which is screwed to T, prevents the levers from turning over

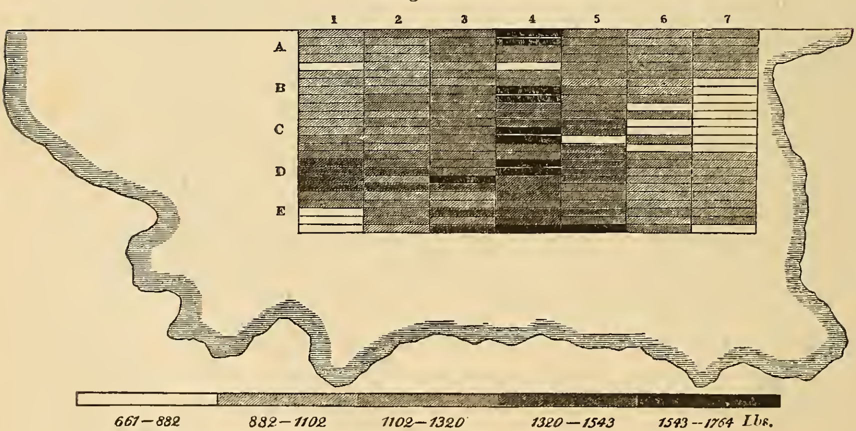
at the moment A tears. The scale-basin S is weighted until the leather tears. The more the leather stretches before tearing

Fig. 2.



and the greater the weight required for tearing, the greater the strength it possesses. The power required for tearing is obtained by multiplying the weight used by 100.

Fig. 3.



No special apparatus has thus far been constructed to test the resistance of leather to breaking, the reason being probably that the task is a very difficult one. Experienced

technologists have made use of the following method: Different pieces of leather are fastened to the edge of the fly wheel in such a manner that they are bent to and fro at every revolution of the wheel. A conclusion as to the power of resistance to breaking is drawn by observing the behavior of the separate pieces up to the moment of breaking, the velocity of revolution being at the same time taken into consideration.

To obtain comparative results care must be had that the pieces to be tested are fastened to the fly wheel in such a manner that the angle of bending is the same for all pieces.

We here give an interesting table by A. Schwarz & Co.,[1] showing the strength of the skin in different places.

	1	2	3	4	5	6	7
	P	*P*	*P*	*P*	*P*	*P*	*P*
A ...	1058	1102	1296	1417	1177	926	1102
	893	1069	1289	1362	1234	1036	937
	882	893	1302	1302	1234	1102	1190
	992	959	1113	1212	1201	1080	1147
	860	959	981	1080	1212	1102	981
B ...	1069	1025	1373	1362	1190	1147	992
	904	992	1102	1362	1256	970	827
	992	1047	1472	1588	1256	1069	760
	904	1102	1417	1544	1234	1135	838
	948	1168	1373	1478	1135	1080	827
C ...	959	937	1433	1450	1214	937	771
	970	1168	1538	1533	1517	1147	771
	1036	1190	1373	1577	1373	970	727
	1147	1256	1494	1599	1192	1235	793
	1312	1278	1433	1417	1467	1036	804
D ...	1224	1157	1450	1522	1438	1168	992
	1406	1245	1509	1588	1433	1135	915
	1433	1450	1433	1544	1356	992	1047
	1323	1340	1566	1433	1323	1003	937
	1516	1406	1461	1455	1268	1036	992
E ...	937	1080	1279	1389	1279	1036	948
	882	1202	1246	1318	1268	1025	1004
	772	1245	1323	1406	1467	1125	992
	662	1212	1268	1461	1301	1012	1125
	618	1069	1362	1698	1698	1307	838

[1] Verhandlungen des Vereins zur Beförderung des Gewerbefleisses in Preussen.

The grain portion of half of a side of leather, 57 inches long and 25 inches wide, is divided lengthwise, as shown in Fig. 3, into seven fields, and the width into 25 fields, so that 175 strips each $8\frac{1}{8}$ inches long and 1 inch wide, are obtained.

In the table the breaking weight P is given in pounds.

In Fig. 3, the results of the table are represented by light and dark shading of the separate fields. On examination it will be found that there is a considerable difference in the tearing strength of the various places even in the grain piece, the middle portion being the strongest, the part towards the head and tail becoming weaker and weaker.[1]

[1] A belt cut lengthwise from a side of leather will therefore be weaker on both ends than in the centre.

PART II.

CHAPTER V.

ANIMAL SKIN.

In the production of leather there are two classes of raw products with which the tanner has to deal, they are—

1. Hides and skins to be converted into leather, and
2. Materials by the aid of which the changing or tanning is effected.

Of the varieties of hides and skins that are employed for tanning purposes and the kinds of leather which they yield we have treated in the opening chapters ot this work. Of the materials used for tanning we shall hereafter treat in Chapters VI. and VII. The object of the present chapter being to explain the structure of the skin and its behavior with reagents, without which knowledge an intelligent prosecution of the art of tanning is rendered difficult and at times hazardous.

Animal skin is constructed with several readily distinguishable layers which behave differently in a chemical as well as in a physical respect.

The upper part of the skin in which the coat of hair, wool, or fur is rooted, is termed the epidermis or cuticle, next beneath this is the corium or leather-skin, and placed next to this is the under-skin.

The epidermis is composed of two layers:—

1. A tissue analogous to the corneous matter of the hoofs, horns, nails, and hair, and is composed of layers of pavement epithelium cells, which when first formed are spherical, gradually becoming dry and flattened; the deeper layers being more distinctly cellular, while the outer one is scale-like, and,

2. An inferior or basement layer, Malpighi's net (*rete Malpighianum*), which consists of a layer of cells charged with fluid, and serves to feed or renew the horny tissue, being in its turn supplemented by vessels situated in the corium.

The epidermis does not combine with tannin or other substances by the agency of which leather is produced. Hence it becomes useless to the tanner, and therefore the first process to which hides and skins are subjected by him is that for removing the hair and epidermis, and the portion of the skin thereby exposed is technically termed the "grain side."

The corium or leather skin is divided into an intermediate layer next to the epidermis and is the actual leather skin.

Both are made up of interlaced bundles of connective tissue fibres, placed crosswise above each other, and running parallel with the surface of the skin; but being more or less filled with fluid matter that serves to renew the cuticle and maintain the skin in a pliant and moist condition. On treating the skin with water these matters are removed, and ultimately there remains but the fibrous portion saturated with water. In this state it appears semi-transparent, and if the water be expelled by a gentle heat, it assumes the physical appearance of horn, constituting only about 32½ to 33 per cent. of the raw hide.

The quality of the leather which can be produced from a skin depends upon the thickness, flexibility, and strength of the corium, which exceeds the combined thickness of all the other layers forming the remainder of the skin.

A peculiar albuminoid substance (coriïn) is stored between the separate fibres of the corium, which substance in a dry state, connects and cements together the raw skin fibres.

The under-skin consists of a loose connective tissue, in which the sweat and fat glands, the blood-vessels and muscular fibres are embedded. It is previously removed in the "beam house" of the tannery and takes no part in the tanning process.

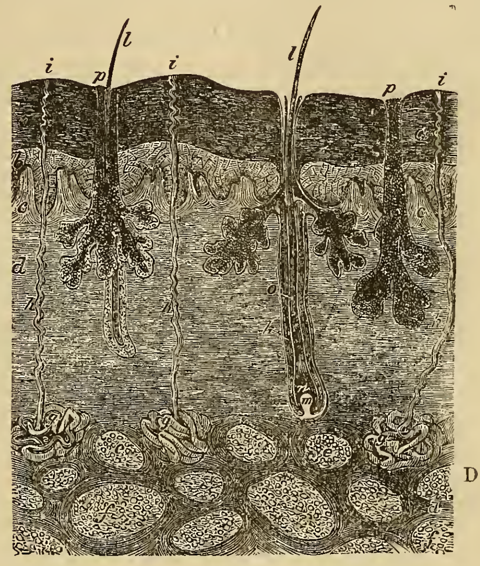
The side upon which the connective tissue of the under skin is located is technically designated as the "flesh side."

Fig. 4 shows an enlarged transverse section of the skin.

D is the connective tissue of the under-skin showing the sweat glands *g*, with the ducts *h*, through which this secretion

passes out to the surface of the skin; *b*, is the *Malpighi* net, and *d* the corium; *c*, papillæ of the skin; *e*, *f*, lobules of adipose tissue; *i*, the external orifices of the sweat or perspiratory glands; *k*, hair follicle; *m*, hair papilla; *n*, hair bulb; *o*, shaft of hair in hair follicle; *p*, openings of the sebaceous glands.

Fig. 4.



The horny layer of the epidermis, *a*, shows on different places, as at *l*, such structures as hair, wool, bristles, etc., which, as seen in the illustration, are not embedded immediately in the surface, but in capsules or shafts, called "*hair sacs*" or "*hair roots*," reaching from the epidermis to the actual corium. In these sac-like depressions the hair is fastened by means of "*hair bulbs*." The hair is coated with a protective layer of fat by small fat glands, the follicles of which enter the upper part of the hair-sac.

Malpighi's rete mucosum accompanies the bottom of the hair sac, the walls of the latter consisting of flat epithelial cells, which develop, only in another form, the hair itself.

The horny shaft of the hair is a section projecting above the

skin, and when completely developed is provided with a minute epithelium, forming the upper skin of the hair.

In boiling with water the connective tissue fibres are converted into glue, the other constituents taking no part in the glue formation. The chemical process taking place during the latter operation is not yet thoroughly understood. The relations of the glue-yielding tissues to the glue, seem to be similar to those existing between starch and paste. Starch, as well as the glue-yielding tissues, is a body of an equally pronounced nature, both being insoluble in cold water and remaining unaltered within certain limits. By boiling with water, they entirely lose their organized structure and form a solution, which on cooling separates, in glue, a colorless jelly, and in starch a body very similar to glue.

The skin, when slowly and completely dried in the air and stored in a dry place, can be kept for a long time. When dried by exposure to strong sun heat, it undergoes an alteration having an injurious effect. The fibres of such skin, after complete softening by soaking, which can only be accomplished with great difficulty, show very little strength. This excessive effect of heat may even cause the skin fibres to dissolve, in soaking, into a glue-like jelly, as has, for instance, been frequently observed in buffalo skins carelessly dried by exposure to strong sun heat.

Moist skins left to themselves decompose in a short time with the usual products of putrefaction making their appearance.

Covered with salt or immersed in strong brine, skins can be kept for a long time.

The chemical and morphological constitution as far as interesting to us, may be briefly given as follows:—

"The connective tissue fibres or fibrillæ form the morphological structure of the skin tissue, the intercellular substance or coriïn, as has been conclusively shown by Rollet,[1] and later by Reimer,[2] lying between them.

[1] Wiener Akademieberichte 30, 37, 39, 308, and Dingl. Polyt. Journal 149, 298.

[2] Dingler, Polyt. Journal, 143, 205.

The *intercellular substance* is an albuminous body soluble, according to Rollet and Reimer, in lime and baryta-water, and also, according to Reimer, in a 10 per cent. solution of common salt, while in one of greater or less concentration it remains insoluble. This behavior towards solutions of common salt and lime-water can therefore be used for separating it.

To prepare coriïn the skin is washed with water until all the soluble albuminoid substances are extracted. The skin is then placed in saturated lime-water six to eight days, which dissolves all the coriïn. The fluid is then filtered and dilute acetic or hydrochloric acid added until the appearance of a slight acid reaction. The coriïn is separated as a flaky precipitate which, by standing quietly, settles on the bottom.

To obtain the coriïn perfectly pure and free from an admixture of cell elements, it is redissolved in lime-water, filtered, and again precipitated with acids. Coriïn precipitated from alkaline or common salt solution is constant in all respects; on detaching it from the filter gray or gray-white lamina are formed which on exposure to the air assume a somewhat darker color. On shaking up with water, it swells up without actually dissolving, and is converted into a paste-like mass. By diluting the latter with water an opalizing fluid is obtained which by standing forms a precipitate, nothing whatever remaining in solution. The addition of a small quantity of common salt increases the swelling capacity, while that of a larger quantity promotes solution, and that of a saturated solution of common salt effects precipitation. By adding spirit of wine to the substance dissolved or swelled in water, a flaky precipitate is separated.

After removing the spirit of wine the flakes act in the same manner as before. Although a separation is also effected by ether, the precipitate by remaining in contact with the ether for some time, can only be swelled with difficulty. Most of the alkaline salts and alkaline earths have, like common salt, a dissolving and swelling effect upon coriïn, small quantities of them increasing its solubility in water, which is a very important fact deserving special attention in tanning.

Most natural waters, as is well known, contain small quanti-

ties of alkaline salts and earths. In using such water for swelling, cleansing, and washing the hides, the swelling influence which these salts have upon the coriïn must be taken into consideration.

In hard water containing much of these salts, the skins must remain for a shorter time than in soft water, *i. e.*, such as contains but a small quantity of salts or none whatever.

In speaking of the use of water in the tannery, we will consider this point more closely.

Since by repeated treating with lime or baryta water, fresh quantities of soluble substances can be constantly withdrawn from the skin, it is not improbable that the intercellular substance is a decomposing product of the connective tissue substance. This circumstance deserves consideration in depilating the skins and hides with lime, for if the latter remain too long in the lime, a part of the connective tissue is converted into soluble substance which is lost in the succeeding cleansing of the hides.

Liming continued too long gives poor weight, and besides the leather prepared from skins too long limed is not strong.

Coriïn is insoluble in acetic acid, and only partly soluble in dilute hydrochloric acid, the undissolved portion settling after long standing, as a flaky precipitate.

Coriïn is readily soluble in pure alkalies and solutions of alkaline earths.

Potassium ferro and ferridcyanide produce no precipitation in acidulated or neutral solution, but effect precipitation when acting upon strongly swelled coriïn.

Ferric chloride, cupric sulphate, cupric chloride, and sugar of lead form no precipitate in neutral or slightly alkaline solutions, while it is produced by basic acetate of lead, excess of tannic acid or basic acetate of iron.

Coriïn is free from sulphur, since on melting the substance with potassium hydrate, no potassium sulphide remains behind.

From the composition found by the elementary analysis, Reimer derives the empirical formula $C_{30}H_{50}N_{10}O_{15}$.

The connective tissue substance[1] differs in many respects

[1] Muspratt, Technische Chemie, Bd. III. 91.

from the intercellular substance, but principally by being insoluble in lime-water which, as we have seen, readily dissolves coriïn. It is dissolved by acetic, hydrochloric, and other acids, but separates again on neutralization.

To prepare connective-tissue substance, place cleansed skin in acetic acid for some time. The skin swells up more and more, while the acetic acid dissolves a portion of the connective-tissue substance. The fluid which becomes of a slimy nature separates on being diluted with water, filtered, and neutralized, and becomes a flaky precipitate. To obtain the substance in a pure state, the obtained precipitate is washed with lime-water in order to remove coriïn which may be present, and is again dissolved in acetic acid. Some potassium is added to the solution until only a very slight acid reaction is perceptible. The fluid is then saturated with common salt, the precipitate, after standing quietly, collecting upon the surface. It is readily filtered, and first washed with slightly acidulated water and then with pure water, and finally dephlegmated with alcohol.

Pure connective-tissue substance swells up when placed in water, and reassumes its original softness.

Acetic acid, as mentioned previously, dissolves connective-tissue substance, the solution containing the substance but not dissolved as glue. Potassium ferro and ferridcyanide produce precipitates in the solution.

By boiling with water the pure substance is readily converted into glue.

Pure lime-water does not dissolve it; an essential difference from coriïn.

Tannic acid, basic acetate of lead, and basic sulphate of iron produce precipitates.

The empirical formula $C_{15}H_{23}N_5O_6$ is derived from the elementary analysis.

This being the same composition as that found by Cramer for the fibroïn of silk, Reimer designates the matter extracted by acids from the skin as skin fibroïn.

The empirical formulæ calculated for coriïn and skin fibroïn give us no information about the relation or close analogy of

the two bodies to each other, their chemical constitution being still unknown.

The most important property of the skin fibre, which deserves special attention from a practical standpoint, is that it swells up strongly in one-half per cent. solutions of inorganic acids, and is entirely dissolved in somewhat concentrated acids if subjected sufficiently long to their action.

The swelling influence exerted by acids upon the skin fibres is, as is well known, used on the one hand to make the skin more sensitive for the reception of the tanning material, and, on the other, to effect the isolation of the compound bundles of connective-tissue fibres into separate fibres, increasing the surface thereby at the same time. It is self-evident that by carrying this swelling process too far, the strength of the fibre suffers injury.

Later on, in speaking of the preparation of the hides and skins for tanning, we shall discuss this point more fully.

CHAPTER VI.

VEGETABLE TANNING MATERIALS.

SECTION I. TANNIN OR TANNIC ACID.

IN considering tanning materials we shall first discuss tannin or tannic acid and the methods for its preparation, and then mention the vegetable substances containing tannin and the quality of leather which each produces, and the power of absorbing and retaining different tannins by the skin; after which we shall mention the mineral substances employed as tannins, and finally name the artificially prepared tanning substances.

Tannin or Tannic Acid.—Tannic acid and vegetable substances containing it are still of the greatest importance to the tanner.

The number of plant substances in which tannic acid occurs

is very large, many plants containing it in all parts, others only in the roots, leaves, blossoms, sap, fruits, or excrescences.

Though these substances may differ very much as regards their origin and properities, they resemble each other in containing a material capable of converting hide into leather, and having the further characteristics of possessing acid properties and an astringent taste, and producing a green or blue precipitate in ferric salt solutions.

These different principles were at first considered as identical with the tannin of the gall-nut or gallotannic acid. A deeper consideration has allowed us to separate them into several varieties, the leading of which are: The tannin of the ordinary gall-nut and of the galls of China and Turkey, or gallotannic acid; the tannin of the coffee, or coffee-tannic acid; the tannin of the cashew, or cashew-tannic acid; the tannin of the yellow wood, or morintannic acid; the tannin of the quercitron, or quercitannic acid; the tannin of the cinchona, or quinotannic acid.

The chemical and physical behavior of each of these tannins varies according to its origin. The tannins were formerly divided according to the color of the precipitates obtained with ferric salts, into such as precipitated the latter "blue-black," and into tannins precipitating ferric salts "green."

The tannins which precipitate the ferric salts blue are met with in the gall-nut in the leaves and bark of the oak, of the poplar, of the pear tree, of the hazel tree, the leaves of the *Arbutus uva ursi*, of the *Arbutus uveda*, of the *Lythrue salicaria*, etc. The tannins which precipitate the ferric salts green are found in the cashew, the cinchona, the pines, the roots of the *Crameria ariandra*, of the *Rheum rhaponticum*, of the *Potentilla tormentilla*, the bark of the *Salic ariandia* and *undulata*, of the *Alvus glutinosa*, of the *Pinus larix*, of the *Phizophora mangle*, etc.

But the distinction above named is not broad enough, since extract of gall-nuts, which would precipitate ferric salts black, colors them green when mixed with tartaric or acetic acid, and, on the other hand, tannin, which by itself colors ferric oxide

green, gives, in the presence of a very small quantity of alkali, a blue color to the precipitate.

It may therefore be supposed that the difference in the behavior towards ferric salts may, in certain cases, be traced to the presence of acids or alkalis in the tannin solutions.

R. Wagner[1] applied the term *physiological* tannic acids to such as are adapted to the formation of leather and precipitate ferric salts black, and that of *pathological* tannic acids to those not suitable for tanning.

The first are found in the vegetable normal tissues, the second in the pathological productions due to the puncture of insects. The precipitates formed by the latter with gelatine, it is claimed, would not be safe from putrefaction.[2]

Pathological tannic acid is claimed to be contained in the barks of the oak, pine, beach, and willow, in bablah (shells and fruits of *Acacia bambola*), in valonia (*Amata valonia*), hulls of dividivi (*Catsalpinia coriaria*), sumac (*Rhus coriaria*), and myrobalans (fruit of *Terminalia chebula*).

These tannic acids yield, when fermented or subjected to the action of dilute mineral acids, no gallic acid, and when distilled dry, no pyrogallol. With ferric salt they give blue-black precipitates.

Pathological tannic acid is claimed to be contained in gall-nuts, catechu, etc. It precipitates glue solutions completely, but is said to give leather of no technical value.

Gallic acid is formed by fermentation or splitting with acids, and pyrogallol by heating. Wagner's assertion that leather of technical value is only obtained with the assistance of tannins designated by him as physiological ones, cannot be accepted as correct, since tanning materials containing only so-called pathological tannin are largely used in modern times either by themselves or mixed with others, and yield satisfactory results.

Our knowledge of the different tannic acids is yet very incomplete, only that contained in gall-nuts having been thoroughly examined. The principal obstacle to a closer de-

[1] Zeitschr. f. analyt. Chemie, 1866, 1.

[2] Bulletin de la Soc. Chim., 1866, ii. 461.

termination of the nature of tannic acids is found in the fact that all tannic acids form amorphous substances which cannot be crystallized, their insolation being consequently very difficult. Besides they are very changeable and decomposable bodies, which are frequently converted into other combinations while in the hands of the chemist.

Gallotannic Acid.—Tannin of the gall-nut. This is, as has been stated, the best known of all the varieties of tannin. Discovered by Lewis in the eighteenth century, gallotannic acid was particularly studied by Pelouze, who perfected a process first broached by Lambert for its extraction, which is yet followed, with the difference only of a few details.

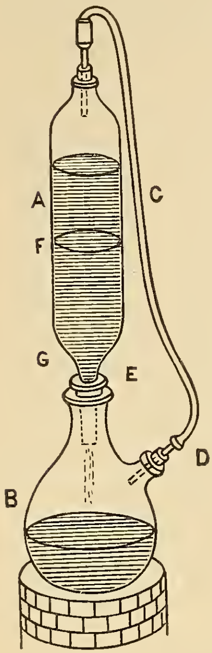
This process is based on the following principles: Of all the matters contained in the gall-nut, tannin has the greatest solubility in water. Dry tannin is insoluble in anhydrous ether, but in presence of a small quantity of water a solution of tannin is formed in the aqueous ether; this syrupy solution is not mixable with ether, but it dissolves in alcohol; mixed with water, this solution of aqueous ethereal tannin divides itself into three layers: the lower layer is a solution of tannin in the aqueous ether; the second, a solution of tannin in ethereal water; and the third is ether, nearly pure, containing very little tannin.

Thus it results, that by covering coarsely pulverized gall-nuts with anhydrous ether, there exudes some ether slightly charged with tannin; with ether containing water the liquid divides itself into three layers similar to those described above. With a mixture of ether and alcohol there runs a homogeneous solution of tannin in the alcoholic ether.

The extraction is made in a displacement apparatus, cold. Pelouze employed the apparatus of Robiquet and Boutron as used for the preparation of amygdaline. Fig. 5 represents this digester. It is an elongated glass vessel A, having an orifice at the top, which is fitted with a ground glass stopper, and contracting towards the other extremity, which fits tightly into the neck of a bottle or matrass B, which receives the extract. Sometimes the lower bottle has a second tubular opening, D, for the purpose of receiving a cork furnished with a tube, to which

a connector, C, of rubber is appended, the other end being attached to a similar tube fitted in cork which closes the top orifice. Between F and G is the pulverized gall, and in E is a little batting of cotton. This adaptation causes the filtration to take place more readily, whilst it prevents contact with any further quantity of air beyond what is contained in the apparatus. After the space between F and G has been filled with coarsely pulverized gall-nut, or two-thirds of the space of the vessel A can be so filled if desired, pour in a mixture of 9 parts of ether and 1 part of water, so as to cover the solid substance with a liquid column of a few centimeters. After twenty-four hours' contact, and after having agitated the mixture, the liquid is run off into the lower vessel by putting the tube at the top of the eking-piece in communication with the lateral tube of the lower vessel at D, by means of the gum tube C. This liquid divides itself into two distinct strata, the lower of which is a thick and syrupy solution of tannin in the slightly hydrated ether; the upper stratum is a very weak solution of tannin and gallic acid in the ether. The upper layer is decanted, while the lower one is washed with a little ether and evaporated by placing the exsiccator above or over a warm sand-bath, or under the receiver of an air-pump, or steaming water, or by putting it on the stove in shallow vessels. The tannin remains in the form of a swollen yellowish, amorphous, friable mass, which may be purified by dissolving it again in very little water, adding some ether and evaporating the syrupy layer which separates, and drying it at 248° to 266° F.

Fig. 5.



To exhaust gall-nuts Mohr uses a mixture of 4 parts of ether and 1 part of alcohol, or equal parts of the two liquids. The ether is distilled and then it is dried.

The industrial preparation is effected by one or another of these methods with appropriate apparatus.

Thus obtained the tannin presents itself in the form of an amorphous, yellowish, friable mass, odorless, of an astringent taste, very soluble in water, hardly soluble in ether. The aqueous solution has an acid reaction; put in contact with animal membranes (skins, etc.), it loses its tannin which fixes itself on the membrane to form an insoluble and imputrescible compound. The solutions of gelatine precipitate it also, forming a combination.

Another modification of the method just detailed was introduced by Domine, and offers the advantage of yielding a larger product, while it admits also of being applied on a large scale for the purposes of the manufacturer. He places the powdered galls in a damp cellar for several days, during which they absorb moisture; the powder is next transferred to a wide-mouthed jar, and made into a paste with ether of a specific gravity 0.75. After this the vessel is hermetically closed, and the contents allowed to digest for twenty-four hours. At the expiration of this time the pasty contents are transferred to a strong linen bag and subjected to gradual pressure, when the ethereal extract of tannin, having a dark syrupy consistence, flows off into the receiver. This liquid must be evaporated to dryness at a gentle heat, by which the tannic acid is left in the form of light-colored resin-like scales. The compressed residue is further treated with ether, to which six per cent. of water is added in the same manner as when preparing the first extract, and on expelling the fluid by a gentle heat, a residue of tannin is obtained. It is, indeed, more impure than the above, as it contains chlorophyll, volatile oil, and gallic acid; still the tannin thus prepared answers very well for many industrial purposes.

Sulphuric, hydrochloric, arsenic, and phosphoric acids, marine salt, or acetate of potash, separate the tannic acid of the aqueous solutions, concentrated under the form of insoluble combinations. Heated tannin melts and decomposes at about 410° to 419° F. in carbonic acid, into pyrogallic acid and metagallic acid; the proportions of these two acids vary with the temperature.

At 482° F. metagallic acid only is obtained. Heated in a platinum cap on a Bunsen burner it melts, swells, ignites, and burns with a clear flame, leaving a residue of charcoal. Ozonized air browns it and fluidifies it, and terminates by converting it entirely into carbonic acid and water. Aqueous solutions of tannin absorb ozone energetically and become of a brown-red; by a more lengthened action of the ozone the color becomes clearer and there is very soon left but little of the substance in solution. Before this stage we ascertain the production of oxalic acid and of a substance which reduces the cupro potassic liquor.[1]

A weak aqueous solution of tannin absorbs the oxygen, while freeing an equal volume of carbonic acid; at the same time it is troubled by the deposit of gallic acid.

Tannin, dissolved several times in water and evaporated by heat, transforms itself gradually, by contact with the air, into a brown insoluble substance (oxidized tannin of the ancient chemists). Oxygenized water and oxygenized essence of turpentine have no action. A solution of iodic acid reacts even when cold on the tannin with the production of carbonic acid mixed with a little oxide of carbon. Bromine reacts briskly and gives a brown resin. Chlorine attacks tannin also and colors its solutions brown; iodine finely pulverized dissolves in water charged with tannin.

Concentrated sulphuric acid dissolves tannin with a lemon-yellow tint or yellow-brown, passing to purple-red when hot, freeing sulphurous acid; then the color becomes brown.

Tannin boiled or digested while hot with weakened sulphuric acid is transformed into gallic acid (Liebig). According to Strecker,[2] some glucose is separated; at the same time, also, some traces of ellagic acid and ulmic matters.

According to this Strecker considered tannin as a glucoside, and gave it the formula $C_{27}H_{22}O_{17}$. He represented his decomposition by the equation: $C_{27}H_{22}O_{17} + 4H_2O = 3C_7H_6O_5 + C_6H_{12}O_6$.

[1] Gorup-Bisanez, Ann. der Chem. u. Pharm., cx. 106.

[2] Annal. der Chem. u. Pharm., lxxxi. 243; xc. 328; Chem. Soc. Quart. Journ., v. 102; Phil. Mag. (4) viii. 157.

More recent experiments have proved that tannin must not be considered as a glucoside, and that the formation of sugar was due to the accidental presence of glucosides foreign to its real composition. According to Rochleder and Kawalier, tannin boiled with hydrochloric acid, protected from contact with air, furnished variable proportions of ellagic acid and of sugar. Nitric acid attacks tannin in watery solution, by coloring at first the liquor reddish-yellow, and lastly producing oxalic acid.

A solution of tannin increased with a solution of osmic acid at 3 per cent. takes a dark-blue tint and leaves after evaporation a dark-blue residue. This residue, treated by the osmic acid solution, produces oxide of osmium and a liquor which, being increased with ammonia, is red-brown and produces by evaporation some crystalline needles formed of a mixture of oxalic acid and probably of suberic acid, also some ulmic matter.[1]

According to Rochleder and Kawalier,[2] tannin heated with alkalis in a current of hydrogen, splits into gallic acid and a gummy matter. Hydrate of baryta furnishes under the same circumstances some gallic acid and some glucate of baryta. According to Liebig, potash transforms tannin into gallic acid, which a lengthened ebullition with potash converts into carbonic and pyrogallic acids. Being boiled for a few hours with its weight of neutral sulphate of potash and of soda and 12 parts of water, there is a formation of 5 to 6 per cent. of a body which possesses the composition of sugar, without having its properties. (Knapp.)

Chromic acid in aqueous solution, while hot, decomposes tannin completely, freeing carbonic acid; bichromate of potash precipitates it in yellow-brown or black.

Peroxide of manganese boiled with tannin, with or without sulphuric acid, disengages carbonic acid and produces a brown extractive mass. Tannin reduces permanganate of potash solutions by taking from it about 0.6 part of oxygen for 1 part of tannin.

[1] Bontlerrow, Journ. Prac. Chem., lvi. 207.

[2] Wiener Akadem. Ber., xxv. 558.

It acts as a reducer on ferric salts, and the salts of copper, mercury, and of silver, by bringing them back to the inferior degree of oxidization or by precipitating the metal.

The impure tannin solutions, such as are obtained by a simple infusion of gall-nut, modify themselves when kept in contact with the air; some carbonic acid is freed at the same time that there is a production of gallic acid and of allagic acid on account of a kind of fermentation, called gallic fermentation.

Constitution of Gallotannic Acid.—The experiments of Strecker induced that chemist to consider the tannin of the gall-nut as a glucoside of gallic acid. The more recent researches of Schiff are contrary to this opinion. In fact, Schiff has succeeded in synthetically preparing tannin free from sugar, starting from the gallic acid. This fact had already been surmised by Löwe, but he did not give it its real significance.[1]

According to Schiff, gallic acid crystallized and dried at 50° F., treated at 212° to 248° F. with oxychloride of phosphorus, disengages hydrochloric acid. There is a formation of a yellow powder which is washed with anhydrous ether and dissolved in water. After twelve hours we separate a certain quantity of unattacked gallic acid; the liquid is precipitated with marine salt; the emplastic precipitate is washed in salt water, then dissolved in absolute alcohol; several times its volume of ether is added to the solution; it is filtered and the ether is distilled; lastly it is dried. The residue presents all the properties of tannin and may be converted into crystallized gallic acid by ebullition with hydrochloric acid. According to these experiments tannin should be digallic acid:—

$$C_{14}H_{10}O_9 = C_6H_2 \begin{cases} COOH \\ OH—O—C_6H_2 \\ OH \end{cases} \begin{cases} COOH \\ OH \\ OH \end{cases}$$

Schiff has analyzed two tannates of lead obtained with acetate of lead used in excess or in insufficient quantity; the one answers to the formula $C_{14}H_4Pb_3O_9$, and the other to the formula $C_{14}H_6Pb_2O_9 + 2H_2O$.

[1] Löwe, Journ. Prac. Chem., cvii. 464; H. Schiff, Deutsch. Chem. Gesel., 1871, 231 and 967.

The new formula of tannin is confirmed by the analysis of the tetracetic derivative formed by the action of the acetic anhydride on the tannin, $C_{14}H_6(C_2H_3O)_4O_9$, a colorless body, crystallizing in peaks, having the form of cauliflower, hardly soluble in water, soluble enough in boiling alcohol, and not reacting any longer on ferric salts. Concentrated sulphuric acid converts it in rufigallic acid at 212° F.

Rufigallic acid should be the anhydride of tannin or of gallic acid and should answer to the formula $C_{14}H_8O_8$.

According to all these results, it is probable that vegetables containing tannin under the form of a polygallic glucoside are very alterable and of which a portion would remain undecomposed in ordinary tannin.

Tannomelanic Acid.—According to Büchner, tannomelanic acid is obtained, as a product of the decomposition of ordinary tannin, by a prolonged ebullition of a solution of gallotannate of potash. The tannin is dissolved in a boiling solution of carbonate of potash of a density of 1.27, as long as there is any effervescence; then the liquid is kept boiling until a testing quantity, increased with acetic acid, remains limpid after cooling. It is supersaturated with acetic acid, and it is evaporated to a dry state by means of steaming. The residue is exhausted by alcohol, which dissolves some acetate and some gallate of potash. The residue is dissolved in water and the solution is mixed with acetic acid and acetate of lead, which causes a precipitation of tannomelanate of lead under the form of a brown-black powder.

The composition of this acid appears[1] to be represented by the formula $C_6H_4O_3$, and its formation at the expense of the gallic acid would be explained by the equation $C_7H_6O_5 + O = C_6H_4O_3 + CO_2 + H_2O$.

Tannopinic Acid.—Rochleder and Kawalier[2] give this name to a derivative of tannin which is found towards spring in the needles of the Scotch pine. The alcoholic extract distilled after adding water, furnishes an aqueous liquor from which some resin has separated. This liquid is precipitated by fractioning

[1] Büchner, Am. Chem. u. Pharm., liii. 373.

[2] Wiener Akadem. Ber., xxix. 22.

with neutral acetate of lead. The precipitate is dissolved with weakened acetic acid, the solution is precipitated with basic acetate of lead, and the precipitate suspended in water is decomposed by sulphuretted hydrogen. The hot aqueous solution of this acid oxidizes rapidly in the air.

The authors named give it the formula $C_{28}H_{30}O_{18}$(?).

Tannoxylic or Rufitannic Acid.—Product of the oxidation of gallic acid under the influence of alkalis.

To obtain it, dissolve some tannin, cold, in a moderately concentrated solution of potash; the liquid is left to itself, in contact with the air, until it has taken a dark red-brown tint, then precipitated with acetate of lead; the tannate of lead mixed with the tannoxylate is taken out by means of hot acetic acid; the insoluble residue is treated hot with a mixture of alcohol and sulphuric acid. A dark red solution is thus obtained, of which the acid is taken by distillation of the alcohol, under the form of an amorphous brown-red mass. Its composition appears to answer to the formula $C_7H_6O_6$. There would be produced at the expense of the gallic acid[1] by addition of oxygen $C_7H_6O_5 + O = C_7H_6O_6$.

Many of the other tannic acids, which have thus far not been thoroughly examined, show properties corresponding more or less in their behavior.

We will here consider somewhat closer the quercotannic acid as being highly important to the tanner.

This was formerly considered as identical with gallotannic acid, but it differs materially in its composition, properties, and products of decomposition. Stenhouse showed conclusively that quercitannic acid, on decomposition with sulphuric acid, does not give gallic acid, nor pyrogallic acid, when subjected to dry distillation. The chemical formula of quercotannic acid is according to Grahowsky[2] and Oser[3] $C_{20}H_{20}O_{11}$. It forms a yellow brown amorphous mass readily soluble in water and alcohol; the aqueous solution is precipitated with sulphuric acid in red-

[1] Buchner, Am. Chem. Pharm., liii. 369.

[2] Wiener Akadem. Ber., 1867, lvi. 387.

[3] Wiener Akadem. Ber., 1876, lxxii. 165, und Handwoerter buch der Chem., Bd. ii.

brown flakes. With solutions of glue, tartar emetic, and quinine, it gives precipitates like gallotannic acid. It changes ferric chloride into a deep black fluid, which is colored red by an addition of sodium carbonate.

Quercotannic acid is easily oxidized by exposure to the air, especially when in alkaline solution; 100 grms. of the acid absorb 12.8 grms. of oxygen.

By boiling with dilute sulphuric acid quercotannic acid ($C_{20}H_{20}O_{11}$) is resolved, with absorption of water, into *quercus red*,[1] $C_{14}H_{10}O_6$, and sugar, $C_6H_{12}O_6$ (Oser[2]). According to Grabowsky *quercus red* is $C_{12}H_{14}O_7$, the difference appearing to be due to the temperature and duration of decomposition or the quantity of acid used.

Quercus red is a red amorphous body insoluble in water and ether, but soluble in water and ammonia. Water precipitates it from an alcoholic solution, and acids from an ammoniacal solution.

Quercotannic acid in aqueous solution compounded with cinchonin acetate gives a precipitate with the formula $C_{20}H_{24}N_2O(C_{20}H_{20}O_{11})$.[2] In washing the precipitate it is not insoluble in water but dissolves more readily in acetone. This solution is precipitated with solution of barium acetate in acetic acid.[3]

Besides quercotannic acid, oak bark contains *quercus bitter* or quercin as Gerber[4] terms it. It is a crystallizable bitter substance which Gerber obtained from a decoction of bark prepared with milk of lime after precipitation with potassium carbonate and evaporation. The small white crystals possess no odor and a very bitter taste. They dissolve in thirteen parts of cold water, but more readily in warm, and also in aqueous but not in absolute alcohol, and in ether and oil of turpentine. From hot hydrochloric acid or acetic acid they crystallize without change, but are colored by nitric or sulphuric acid.

[1] The well-known fact that oak-tanned leather on coming in contact with acids, turns red, may be traced to this.

[2] Wiener Academ. Ber., 1876, lxxii. 165.

[3] Wiener Akadem. Ber., 1876, lxxii. 165.

[4] Handwoeterbuch der Chemie, Bd. ii. 1046; Berzelius's Jahresber., xxiv. 635.

We will here mention the *querphlobaphene*,[1] which resembles *quercus red*, and which is prepared by treating bark completely extracted with water with ammonium, and precipitating with hydrochloric acid. Its composition corresponds to the formula $C_{24}H_{24}O_{14}$, or nearly $C_{14}H_{14}O_7$. Querphlobaphene dissolved in as little ammonium as possible gives with calcium chloride or barium chloride as precipitates: $C_{24}H_{22}O_{14}Ca$, or $C_{20}H_{22}O_{14}Ba$. By fusing this body with potassium hydrate, it yields *phloroglucin* and *protocatechuic acid*, and sometimes a small quantity of pyrocathechin.[2]

The property of tannic acid of forming insoluble combinations with earthy alkaline salts is of practical importance in tanning. By the use of hard water a loss of tannic acid may be caused by the formation of insoluble barium or lime combinations with the tannic acid. As the loss thus caused is by no means a small one, it is recommended for tanneries using very hard water to purify it before leaching the bark.[3]

A further property of tannic acid deserving consideration is that it can be brought into fermentation by fungi and ferments.

In tanneries where scrupulous cleanliness is not the rule, it is frequently the case that the edge of the ooze vats is covered with a rank fungous vegetation. Many tanners cannot know that these fungi decompose tannic acid into acetic acid, lactic acid, etc., or they would surely be more careful to remove this foul matter.

Only since we have acquired the knowledge how to determine tannic acid analytically, has it been found that plants may contain very varying quantities of tannic acid in their separate parts, or in the different stages of their development.[4]

[1] Wiener Akadem. Ber., 1867, lvi. 387.

[2] Annal. der Chemie u. Pharmacie, cxlv. 1.

[3] In many tanneries the water is filtered through exhausted tan, which though quite suitable, is rather a laborious method. The small quantity of tannic acid still contained in the tan precipitates the lime and magnesia salts of the water. The principal objection to this method of purifying the water is that organic acids such as acetic, lactic, propionic acids, etc., may get into the water, and that by using such water for leaching fresh tan a decomposition of the tannic acid may be caused by the ferments.

[4] Through researches made by Schulze (Dingler's Polyt. Journal, clxxxii. 158), it was found that oaks twenty-four to thirty years old yield tan containing a very

In perennial plants the roots, barks, and branches of most trees contain tannic acid, as frequently do also the leaves, follicles, and fruits of bush-like and tree-like plants, especially when full-grown. Tannic acid was formerly supposed to be the product of a commencing process of decomposition of the cell substance, and its formation a peculiar decomposing process of the cell membrane, but recent researches have proven that tannic acid is in most cases a primary product of vegetable life, as shown by its frequent occurrence in young plants while yet in the first stage of development.

The action of the different tannic acids towards the corium or leather skin varies greatly.

Observations of practical men have shown that vegetable substances the tannic acid of which, when heated, forms pyrogallic acid, furnish leather less capable of resisting water, and consequently less suitable for the consumer, than tannic acids which, when heated, yield pyrocatechin.

The extractive substances, such as coloring matter, resins, pectine, and pectic acid, organic acids, sugar, etc., exert a material influence upon the value of a tannic acid. The coloring matter, for instance, may injure the appearance of the leather, and the resins and other extractive substances the quality.

The influence exerted by resins, pectine substances, etc., has unfortunately been but little studied by chemists, and the judgment of this matter is limited.

Section II. Vegetable Tanning Materials.

But few of the large number of vegetables containing tannic acid are used in tanning, though in modern times the number has been largely increased by diligent researches made with a view to obtain cheaper tanning materials.

We shall here briefly discuss the most important tanning

high percentage of tannic acid, while that from oaks eighty to one hundred and twenty years old contained far less. But the percentage of tannic acid in the younger trees varies frequently so much, that that contained in the older ones may often be as large as in the younger trees.

materials, first mentioning the inspissated vegetable juices which are imported.

Rutea is the inspissated juice of *Rutea formosa*, and is only used for tanning in the northwest of India.

Kino is the inspissated juice of *Pterocarpus erinaceus* and *marsupium.* Numerous varieties of kino are known in commerce, though the principal ones are those coming from Africa and Malabar. The African kino, which is the best, and but seldom found in commerce, is the inspissated juice of *Pterocarpus erinaceus.*

The *Malabar* or East Indian kino is derived from *Pterocarpus marsupium*, a tree indigenous to After India, Malabar, and Ceylon. Both varieties of kino are very rich in tannic acid, that of the latter being identical with gallotannic acid, it yielding, on heating, pyrogallic acid. On account of its high price, and the disagreeable red color it imparts to the leather, this tanning material is but little used.

Gambier is an extract from the leaves of *Uncaria gambir.* It forms cubical pieces $\frac{1}{24}$ to $\frac{1}{8}$ inch thick of a light and dark rust or sometimes gray color, which float upon water and are very friable. Gambier is slightly soluble in cold water, but readily in hot. Its percentage of tannin is quite high.

Catechu, or *terra japonica*, is the dry extract from the core wood of a mimosa, *Acacia catechu*, growing in the East Indian islands. Its principal constituents are: Catechin, a brown substance which can be precipitated from its solution with glue, and catechutannic acid, which appears to be formed from the catechin by exposure to the air. It colors ferric oxide green, and gives a green-black precipitate with ferric salts. A judgment of the value of catechu is formed by its external color, hardness, taste, solubility in spirit of wine, etc. Genuine catechu melts upon the tongue, while non-genuine sticks to it. Adulterations with blood, sugar, etc., can be detected by the characteristic odor of these admixtures when burnt. The leather produced with catechu is not of a particularly good quality, it being of a dark color, permeable to water, spongy, and at the same time hard.

Gall-nuts are the richest in tannin of all tanning materials. They are morbid excrescences of the leaves and young branches

of *Quercus infectoria*, Oliv., formed by the puncture of gall-flies (*Cynips gallæ tinctoria*), belonging to the *Hymenoptera*, for the purpose of depositing their eggs. As the latter develop, excrescenses called galls or gall-nuts are formed on the punctured places by the exudation of sap and enlargement of the cells. The larvæ which are inclosed in the galls are supported by the juices of the plant until they become perfect insects, when they perforate the gall and escape. When this happens the excrescense loses much of its astringent principle and becomes lighter in color and finally entirely white, while if collected before the entombed insect is completely developed the galls are of a dark to blackish color, and much richer in tannin.

The latter are known in commerce as *green galls*, and come from Aleppo, Smyrna, and Mesopotamia.

Gall-nuts are also imported from *Cypria*, *Karamania*, etc., though they are not so good as the Aleppo galls, with which they are sometimes mixed.

European galls, formed by the puncture of other species of gall-flies of other varieties of oaks, are not so good as the Aleppo galls. They come from the Morea, Italy, Hungary, and Istria. Gallotannic acid is, as previously mentioned, the most accurately known.

Galls (Knoppern) formed by the puncture of a gall-fly (*Cynips quercus calycis*) in the young fruits of *Quercus pedunculata*. They are principally collected in Hungary, Dalmatia, and Slavonia, and contain, besides a small quantity of gallic acid, much tannin closely resembling gallotannic acid. The percentage of tannin amounts, according to Mueller, to as much as 50 per cent.

Chinese Gall-nuts form irregular roundish bulbs of the size of a hazel or walnut, which inclose the insect. Their rind is smooth and felt-like, of a gray or reddish color, and very thin, and consequently fragile. They show no vegetable structure, but a dense, brilliant, resinous fracture, and are said to be derived from a species of sumach. They are much in demand on account of their high percentage of tannin, which, according to Mueller, amounts to as high as 65.5 per cent.

Rove.—The article known by this name, which is brought

into commerce ground and pressed in bricks, is the so-called *Bassora* gall-nut, and is found in Persia and Asia Minor. It is principally exported by way of Smyrna. It contains about 27 per cent. of tannic acid. Mixed with oak or fir bark, it is, according to Eitner, well adapted for tanning sole leather.

Sumach consists of comminuted leaves, stems of blossoms, and branches of several *Rhus* species, such as *Rhus coriaria*, *R. cotinus*, *R. glabrum*, *R. canadense*, *R. typhinum*, *R. pentaphyllum*, *Arbutus uva ursi*, *Coriaria mystifolia*.

The following varieties are found in commerce:—

Sicilian Sumach, from *Rhus coriaria*, is the most valued. It is divided into two qualities, the best being of a greenish-yellow color, while the inferior variety is of a more rusty-yellowish color, and has less smell and less tannic acid.

Italian Sumach, which is also derived from *Rhus coriaria*, is a dirty-green powder. It is far inferior in tanning capacity to the Sicilian variety, it being besides frequently adulterated with *sondro* leaves.

Spanish Sumach.—Three varieties of this occur in commerce, viz: *Malaga* or *Priego*, *Malino*, and *Valladolid*, the last two being of less value than the first.

Tyrol Sumach, the odor of which resembles that of oak bark, is derived from the leaves and stems of *Rhus cotinus*. Like the *Italian* and *Sicilian* sumach, it is frequently adulterated with fig leaves.

French Sumach (from *Coriaria mystifolia*).

There are four varieties: *Fauvis*, *Redoul*, *Donzère*, and *Pudis* sumach, the last two being less liked than the others.

The "*Tezera*" sumach, used by the Arabs for tanning morocco leather, is derived from *Rhus pentaphillum*.

American Sumach is derived from *Rhus canadense* and *R. glabrum*. Large quantities of it are used in the United States, nearly all the morocco manufacturers mixing it with an equal quantity of Sicilian sumach to form the tanning liquor, which is forced through the goat skins by hydrostatic pressure. Sumach is also used in tanning buffed leather. Large quantities of American sumach are shipped from Georgetown, D. C., and Alexandria, Va.

Swedish Sumach is prepared from the leaves of the bear-berry (*Arbutus uva-ursi*).

It is not yet definitely determined whether all the different varieties of sumach contain the same or different kinds of tannic acid, though the latter is the most probable.

The tannic acid contained in the *Sicilian* sumach is, according to Stenhouse,[1] identical with gallotannic acid. In old sumach, the larger portion of the tannic acid has been converted into gallic acid and sugar.

Leather prepared with sumach possesses but little capacity for resisting water, and is therefore principally used for the uppers of ladies' fine shoes, book-binding, portfolios, pocket-books, linings, bindings, skivers, etc.

Valonia is the acorn-cup of *Quercus ægilops*, prickly-cupped oak, a tree growing in abundance in the islands of the Grecian Archipelago. The tannic acid of valonia is not known in a pure state, as it always contains gallic acid. The use of valonia has recently much increased in Europe, it being especially employed, mixed with oak tan, for sole-leather in the last two spreadings of the hides in the binders. Leather prepared with valonia, is said to be harder and less permeable to water than that made with oak bark, its weight being also increased. The price of valonia which contains a considerable percentage of tannic acid, is low compared with that of tan, and it is much used by English tanners.

Divi-divi consists of the dried pods of a bush (*Cæsalpinia coriaria*) indigenous to South America. Leather tanned with the extract becomes very soft and spongy, and on exposure to the air assumes a more or less brown to brown-red color. The extract of the divi-divi pods is also brought into commerce. The tannic acid differs from the gallotannic acid, and, when heated, does not yield, like the latter, pyrogallic acid.

Myrobalans, the dried fruit of *Terminalia chebula*, is principally collected in India. The fruits exported by way of Calcutta are of a roundish shape, gray-black color, and hard and astringent. They contain, principally in the husk, a consider-

[1] Dingl. Polyt. Journ. clxv. 150.

able quantity of gallic acid, which, according to Stenhouse, differs so far from gallotannic acid as not to yield, on boiling with dilute sulphuric acid, gallic acid, but a reddish-brown substance insoluble in spirit of wine.

Myrobalan is used in Europe in tanning as an addition to oak bark.

Bublah is the husk of the fruit of *Acacia bambula*. It comes from India, and contains considerable tannic acid.

Of the other foreign materials containing tannic acid, which, on account of their high price, etc., are more extensively used in dying and coloring than tanning, we will mention:—

Logwood, which is derived from *Hæmatoxylon campeachianum*, a *Cæsalpina* growing wild in Yucatan and some of the West Indies.

Fustic, obtained from *Morus tinctoria*. It contains a peculiar tannic acid, moritannic acid, or macherin, which on heating yields pyrocatechin. It is only used for coloring leather.

Weld (*Reseda luteola*) is a plant belonging to the *Resedaceæ*, which grows wild in all European countries, though it is occasionally cultivated in Southern France and Germany.

The following barks are also made use of in tanning, although not so extensively as hemlock and oak barks:—

Larch bark (*Larix Europæa*).—This bark yields a material relatively poor in tannin. It contains, according to Davy, 1.6 to 2 per cent. of tannic acid. The bark is used in England and Ireland for tanning sheep-skins.

Fir bark (*Pinus abies*) is principally used in Europe, in Austrian, Bavarian, Hanoverian, and Upper Swabian tanneries. It is claimed to be especially adapted for "plumping," or the so-called preparatory swelling and tanning of hides.

Hemlock bark is obtained from *Abies Canadensis*.

The bark is light, has a somewhat balsamic odor, and a slightly astringent taste. The tannin is colored green by ferric salts, and brown by potash lye. It is the most important tanning material in America, where it is much used for tanning both sole and upper leathers, two-thirds of all sole and upper leathers produced in the United States being tanned with it. This variety of leather has been only lately appreciated in many

portions of Europe, and our exports of this variety of leather are constantly increasing, but, as has been stated, not so rapidly as they ought to do considering its wearing qualities and its cheapness. A mixture of hemlock bark and oak gives a very serviceable leather, termed "union tannage."

An extract of hemlock bark goes into the European markets under the name of *American hemlock extract*, and it is also employed in portions of this country where bark is scarce.

It is chiefly prepared from thick bark, since the greatest yield of tannin is, according to Eitner, obtained from the rind, and not from the pulp, an analysis of the latter showing 7.7 per cent. of tannic acid, and of the former 11.3 per cent., while the entire bark yielded 10.1 per cent.

Oak barks, from *Quercus monticola* of Michaux, rock chestnut oak, and *Q. tinctoria*, yellow-barked oak, are the most esteemed for tanning purposes in the United States. The best is the first-named variety, and the prime quality is derived from the Blue Ridge, which is the most easterly ridge of the Allegheny Mountains. The principal tanneries using rock-chestnut-oak bark are located in the State of Virginia, the western portions of the Carolinas, and in Tennessee; the bark in the latter State being derived from the Cumberland Mountains. In tanning it is used unmixed, and gives a beautiful "bloom;" the sole leather produced with it being always in demand for both home consumption and for export. The bark of the yellow-barked oak is in tanning commonly mixed with red-oak bark, as the color which the former yields when used alone is objectionable.

The inner bark of the *Q. tinctoria* is the *quercitron* of dyers. The barks of the *Q. alba*, white oak, and *Q. rubra*, red oak, are not esteemed in tanning, the first being poor in tannin and the second imparting an undesirable color to the leather.

Walnut bark from *Juglans regia* gives a very soft leather, but can only be obtained in small quantities.

Lombardy poplar bark gives a light-brown leather with an odor resembling that of Russia leather.

Elm bark, from *Ulmus campestris*, is especially used in Norway for manufacturing the beautiful Norwegian glove leather.

Horse-chestnut bark from *Æsculus hippocastanum.* The bark of this tree contains a tannin which is colored intensely green by ferric oxide. Besides the tannin, which is also found in other parts of the tree, the bark contains fraxin, fraxetin, æsculin, æsculetin, and æsculetin hydrate, a small quantity of a peculiarly yellow crystalline body and a pectine substance which is decomposed into formic acid, oxalic acid, and protocatechuic acid by boiling potash. The leaves of the horse chestnut[1] contain also tannic acid, wax, a variety of rosin ($C_{26}H_{22}O_{n}$) and a resinous substance ($C_{17}H_{28}O_{7}$) possessing a peculiar odor of frankincense. The young leaves and buds contain a peculiar tannin to which Rochleder has applied the term "*phyllocitannic acid.*"

Æsculotannic Acid.[2]—Different kinds of tannic acid are found in the horse chestnut, æsculotannic acid ($C_{26}H_{24}O_{12}$) occurring, according to Rochleder, in the bark, leaves, flower-buds, ripe and unripe seeds, roots, and the trunk. In a pure state it forms an almost colorless amorphous powder readily soluble in water, spirit of wine, and ether. By the action of the air and alkali, or substances containing oxygen, such as chromic acid, it is decomposed into a brown body having the constitution $C_{26}H_{22}O_{13}$. Fusing with potash changes æsculotannic acid into phloroglucin and proto-catechuic acid. Ferric chloride colors the tannic acid green.

An aqueous extract of the bark comes into commerce under the name of "*horse-chestnut extract.*" The percentage of tannic acid in the extract varies according to its specific gravity. It is at present much used in Germany and other portions of Europe as an addition in oak-bark tanning, and is said to give good leather. It is considerably cheaper than quercotannic acid.

Willow Bark.—The following are the principal willow barks used in tanning: *Salix alba*, *S. arenaria*, *S. fragilis*, *S. purpura*, etc. There is not much difference in the value of the barks, though it is claimed that barks containing salicin, as for instance that of *S. purpurea*, are not so good as others. The amount of

[1] Rochleder Wiener Akadem., liv. 24 bis 48; 236 bis 254; 604; 607 bis 657.

[2] Ibid., liv. 607.

tannin varies from 6 to 16 per cent. In Russia willow bark is used for tanning Russia leather, and in Sweden and Norway for preparing the well-known Swedish glove leather. The tannic acid contained in willow barks colors ferric salts green, and, when treated with dilute sulphuric acid, yields sugar and possibly gallic acid, though this is doubtful.

Alder Bark contains a high percentage of tannin, amounting, according to Gassincourt, to 36 per cent.

Beech bark from *Fagus silvatica* mixed with oak bark may be used as a substitute for the latter, but the resulting product is of an inferior quality. It contains, according to Davy, 2 per cent. of tannin, and besides a peculiarly red matter and a substance with an odor of vanilla.

Protaceæ Barks.—The trees from which this bark is obtained are indigenous to the Cape and Australia. The principal ones are the *Protea conocarpa* (knotted tree) and *Banksia serrata.*

The tannin of the latter imparts a beautiful violet-blue color to solutions of ferric salts, while that of the first colors iron-green. Both give a brown color with potash lye.

Snouba Bark.—The *Aleppo* fir (*Pinus halepensis*) yields two important tanning materials, namely, the *snouba* bark, and the *scorza rosa.* The first is the inner bark of the tree freed entirely from the rind, and comes from Tunis and Algiers.

The *scorza rosa* is the rind of the same tree, obtained in Southern Italy, and especially in Sicily, from the living trees in a very rational manner, so that the flesh of the bark remains intact, and produces, like the cork tree, new bark, which is periodically taken off. *Snouza* bark contains 25 per cent. of tannin, and *scorza rosa* 13 to 15 per cent. The tannin colors ferric salts green, while it becomes brown by an addition of potash lye.

Ratanhy root is obtained from *Krameria triandra*, which grows in Peru. The root comes into commerce in a comminuted state, and is very rich in tannin, which is extracted with water, and the resulting solution used as an addition in tanning. The proportion of tannin is, according to Peschir, as much as 42.6 per cent. It corresponds, according to A. Rabe,[1] with the formula

[1] Pharm. Zeitung f. Russland, xix. 577.

$C_{20}H_{20}O_9$. It is not a glucoside, and passes, by the splitting off of H_2O, over into *ratanhy red* $C_{20}H_{18}O_8$.

Avens root, from *Geum urbanum*, contains, according to Trommsdorff, up to 41 per cent. of tannin. Solutions of it have occasionally been used as an addition in tanning.

Tormentil root and *Sassafras root* show a still higher percentage of tannin, the first containing, according to Gassincourt, 46 per cent. of it, and, according to Reinsch, up to 58 per cent. Both roots being very expensive are not often used for tanning.

The wood of the *Algarobia glandulosa* of Gray, *mesquïte oak*, and *Q. virens*, *live oak*, contains much tannin in its entire mass, and is very successfully used in America in place of tan.

Quebracho is obtained, according to a communication by C. Donath,[1] in the province of Santiago from *Aspidosperma quebracho*. It is brought into commerce in blocks with a reddish-brown appearance upon the cutting surface. It costs about $2.75 per 100 lbs., and is said to contain about 20 per cent. of tannin. Before use it is cut into small pieces, which are ground to a fine powder by disintegrators. G. Fraude[2] found in the bark of the wood an alkaloid to which he has applied the term *aspidospermin* $C_{22}H_{30}N_2O_2$, or $C_{22}H_{28}N_2O_2$. Müntz and Schön claim that, by tanning with quebracho, good leather and weight are obtained.

Mimosa.—Besides these the following tannins, the names of which we will only mention, have been proposed and occasionally used: Barks of *Butea frontosa* and *Butea gibsonis*, both indigenous to the West Indies; fruits of *Balsamokarpon brevifolium*,[3] bark of *Eucalyptus*; *Pangue*, a root growing in India; *Pimica granatum*, etc.

We have in the following compiled—

[1] Dingl. Polytechn. Journal, ccxxxi. 451.

[2] Ber. d. deutsch. chem. Ges. 1878, 2189; Dingl. Polytechn. Journal, ccxxxii. 92.

[3] Engl. Patentberichte, 1875, Ramsbacher, Masurer.

The Percentage of Tannin contained in the various Tanning materials determined according to different methods.

Bombay catechu	55	per cent.	according to	Davy.
Bengal "	44	"	"	Davy.
Kino	75	"	"	Vauquelin.
Buted gum	73.2	"	"	Solly.
Aleppo nut-galls	65	"	"	Guibourt.
" " "	60 to 66	"	"	Fehling.
Chinese " "	69	"	"	Bley.
" " "	70	"	"	Fehling.
Istrian " "	24	"	"	Roder.
Valonia	30 to 33	"	"	Fehling.
Ratanhy root	42.6	"	"	Peschier.
" "	38.2	"	"	Gmelin.
Best oak bark	19 to 21	"	"	Fehling.
Old " "	9 to 16	"	"	Fehling.
Young " "	15.2	"	"	Davy.
" " " (taken in spring)	22	"	"	Davy and Geiger.
Gambier	40	"	"	Esenbeck.
Fir bark	5 to 7	"	"	Fehling.
Birch bark	1.6	"	"	Davy.
Beech "	2	"	"	Davy.
Larch "	1.6	"	"	Davy.
Hazel "	3	"	"	Davy.
Chestnut (America)	8	"	"	Gassincourt.
" (Carolina)	6	"	"	Gassincourt.
" (France)	4	"	"	Fontenelle.
" (Spain)	0.5	"	"	Davy.
Horse chestnut	2	"	"	Fontenelle.
Lombardy poplar	3.5	"	"	Fontenelle.
Elm bark	2.9	"	"	Davy.
Ash "	3.3	"	"	Davy.
Willow bark (Leicester)	6.8	"	"	Davy.
" " (inner)	16	"	"	Davy.
" " (middle)	3	"	"	Davy.
" " (branches)	1.4	"	"	Biggers.
Weeping willow bark	16	"	"	Gassincourt.
Alder bark	36	"	"	Gassincourt.
Cherry tree	24	"	"	Gassincourt.
Cornel cherry	19	"	"	Gassincourt.
Elder	2.3	"	"	Davy.
Apricot	32	"	"	Gassincourt.
Pomegranate tree	32	"	"	Gassincourt.
Tormentil root	46	"	"	Gassincourt.
Sassafras root bark	58	"	"	Reinsch.

Sumach (Sicily)	16.2 per ct.	according to Davy.
" (Malaga)	16.4 "	" " Davy.
" "	10.4 "	" " Frank.
" (Carolina)	5 "	" " Gassincourt.
" (Virginia)	10 "	" " Gassincourt.
Avens root	41 "	" " Trommsdorff.

More recent examinations of various substances containing tannin give the following results:—

Fraas found in 100 parts of

	Per cent. of tannin.
Fall tormentils (*tormentilla erecta*)	20.5
" " " " from the marsh	43.2
Dry fall tormentil root	20.0
Sanguisorba officinalis	3.9
Polygonum bistorta	17.1
" " spring	21.1
" " from the botanical garden	17.0
" " leaves in the fall	4.2
" " waste of roots	16.0
Fall polygonum from the marsh	20.0
Summer polygonum from the marsh	26.4
Willow bark from salix purpurea in the fall	5.0
Fir bark from the second sap, 15 to 20 years old	10.8
" " 20 to 30 years old	8.0
" " 30 to 40 " "	7.5
" " 40 to 50 " "	10.7
" " 80 to 100 " "	8.7
Bark cuttings from pine hop poles	9.0
Aspen bark in the fall (12 years old)	2.6
Birch bark (bet. pubesc.)	5.3
Hippophaë rhammoides, fall leaves	5.0
" " young branches	4.0
Old oak branch bark from thin branches in the 2d sap	13.3
" " " " " " 1st "	3.6
" " " medium " " 2d "	8.0
Field oak, 40 to 60 years old, 1st sap	18.0
Crude oak bark covered with rind, 1st sap, 30 years' growth	9.2
Inside of oak bark, 2d sap, 20 years' growth	8.6
" " " 1st " " "	14.6
Inside layer and inside of bark, 1st sap, 24 years' growth	17.0

Only a relatively small number of the many tanning materials enumerated in the foregoing are used for tanning on a large scale. The cause of this may be found partly in the conservative bias of the tanners, and partly in the imperfect knowledge

of the action of the various tanning materials upon the skin tissue. It requires extensive study to become thoroughly conversant with the effects exerted by the various tannins and the extractive resinous substances accompanying them upon the skin tissue.

In most countries only such tanning substances are chiefly used as are produced there in great abundance. In the United States, for instance, hemlock and oak bark are principally used; in France, Germany, and England, oak bark; and in Sweden, Norway, and Russia, mostly the barks of birch, poplar, and alder.

Valonia and mimosa are used as additions to the mentioned materials in Germany and England. Sumach is chiefly employed for the production of morocco and leather for pocket-book-makers' use. Catechu, gambier, and the other exotic substances have thus far been only experimentally used in the United States, but much more largely in Great Britain; while quebracho and chestnut bark have only lately been employed on a large scale in England, Germany, and France.

Practical experiments have shown that there is a considerable difference in the quantity of the various vegetable tannins mentioned which is absorbed by the skin. Whether the greater absorption is to be attributed only to the tannin or to the extractive and resinous substances accompanying it has thus far not been finally determined by experiments. But it may be reasonably supposed that the observed difference must be attributed partly to the larger or smaller absorption of extractive resinous substances contained in varying quantities in the different tannins.

We give in the following a few tables showing the quantities of tannin absorbed by the skin in using different tanning materials.

The following quantities of tannin are required, according to Anthon,[1] *for the conversion of each* 1 *lb. of skin into leather:—*

Of oak bark according to quality	$2\frac{1}{4}$ to 5 lbs.
" oak leaves gathered in May	5 "
" alder bark	9 "

[1] Fortschritt, xxvii. 212.

Of beech bark	9 lbs.
" ash bark	5 "
" aspen bark	5 "
" fir bark	4 "
" maple bark	5 "
" acacia bark	5 "
" hazel bark	5 "
" cherry tree bark	5 "
" larch bark	4 "
" mulberry tree bark	6½ "
" nut tree bark	1½ "
" willow bark	4 to 5 "
" nut-galls	10 oz.
" valonia	1 lb.
" sumach	1½ "
" broom	9 "
" bilberry bush	1 "
" cranberry bush	9 "

Knapp[1] communicates experiments made by Ludwig Kester. The skins as well as the tanned hides were only air-dried, but so that the comparison between skins and tanned hides, consequently the increase in weight, was as assured as possible.

Vegetable tanning material.	Weight of each two calf-skins air-dried.		Increase in weight by tanning.		Consumption of tanning material.	
	Raw.	Tanned.	Absolute.	Per cent.		1 part by weight of air-dried raw skins parts by weight.
	lbs.	lbs.	lbs.		lbs.	
Catechu	2.16	3.15	0.99	45.8	4.4	2.1
Fir bark	2.13	3.19	1.04	49.3	39.36	18.5
Old oak rind	2.14	3.198	1.05	49.4	49.5	23.1
Young oak rind	2.13	3.22	1.09	51.0	26.4	12.3
Nut-galls	2.02	3.14	1.12	55.4	3.52	1.7
Divi-divi	2.21	3.45	1.24	56.2	4.4	2.1
Tormentil	2.34	3.73	1.39	59.7	19.8	8.4
Myrobalan	2.19	3.56	1.37	62.5	4.4	2.1
Dohra bark	2.09	3.51	1.42	68.0	4.4	2.1
Sumach	2.23	3.77	1.54	69.0	9.9	4.4

According to these experiments, the quantity of tannin absorbed varies between 46 and 69 per cent.

[1] Dingl. Polytechn. Journal, ccxxvii. 86.

Prof. Müntz and Dr. C. Schön[1] also communicate experiments regarding the absorption of different tannins by the skin.

100 parts of entirely dry skin give, according to them—

TABLE I.

Tanned with		hemlock bark	255.7
"	"	fir bark	240.1
"	"	quebracho bark	232.0
"	"	chestnut bark	219.0
"	"	à la garouille	210.0
"	"	oak bark	206 to 209

From the results obtained it seems that hemlock and fir bark give the best weight, which Müntz and Schön attribute to the great quantity of resinous substances absorbed in both cases, besides the tannin. They tried to remove the quantity of resinous extractive substances contained in leather tanned with different tannins by washing with ether and alcohol, and found that the quantity extracted amounted—

TABLE II.

In hemlock leather	to	23	per cent.
" quebracho leather	"	8	"
" à la garouille leather	"	8	"
" oak bark leather	"	4	"

The varying quantities of resinous substances contained in the different kinds of leather make, it is said, the difference in the solidity, flexibility, etc., of the leather. The larger the quantity contained in the leather, the less solid and the more brittle it becomes.

Müntz and Schön make the assertion, which according to our opinion is untenable, that leather is a solid combination, and consider, according to this, the resinous substances as injurious admixtures. The greater the percentage of pure tannin in the leather, the better, according to Müntz and Schön, is the leather.

To form a judgment of the real value of leather tanned with different tanning materials, they endeavored to remove all resinous substances by extraction and washing with ether and

[1] Gerberzeitung, 1881, No. 32.

alcohol, after which they dried the leather completely, and calculated from this the quantity of tannin absorbed.

The experiments gave the following results:—

TABLE III.

	Parts of skin.	Parts tannin.
Hemlock leather contained in	43.91	29.23
Sumach leather " "	45.10	29.70
Fir leather " "	46.70	42.60
Quebracho leather " "	48.70	36.70
Chestnut leather	52.56	44.08
Oak-bark leather	53.36	41.16
Leather in à la garouille	54.19	35.13
Oak bark (3 years in the pit)	56.30	39.00

By calculating the above table to 100 parts of skin, we obtain the following figures:—

TABLE IV.

100 parts of skin contain pure tannin—

As hemlock leather[1]	64.2 per cent.
" sumach leather[1]	61.2 "
" fir bark leather[1]	90.8 "
" quebracho leather	75.3 "
" chestnut leather	85.2 "
" oak-bark leather	76.9 "
" à la garouille[2]	64.8 "
" oak bark (3 years in the pit)	70.2 "

The percentage of glue, tannin, and nitrogen in leather perfectly dry and free from all soluble substances, calculated from Table III., should be as follows:—

TABLE V.

	Glue.	Tannin.	Nitrogen.
Hemlock	60.40	39.96	10.88
Sumach	60.40	39.60	11.00
Fir bark	52.50	47.50	9.56
Quebracho	57.10	42.90	10.40
Chestnut	53.97	46.30	9.79
Oak	55.87	44.13	10.24
À la garouille	60.40	39.60	10.94
Oak (3 years in the pit) . .	58.75	41.25	10.65

[1] The figures for hemlock, sumach, and fir bark leather, given in the "Gerberzeitung," are wrong. They should be 66.5 per cent. for hemlock, 65.8 for sumach, and 91.2 for fir bark.

[2] À la garouille is probably a variety of leather obtained by mixing the bark of *Daphne Laureola* with *Quercus*.

By calculating from Table V. how many pounds of leather free from resin are obtained from 220 lbs. of dry skin, we obtain the following figures :—

Table VI.

Hemlock	365.2 lbs.
Quebracho	380.6 "
Chestnut	407 "
Oak	374 "
à la garouille	363 "

The last table shows that leather tanned with hemlock and à la garouille absorbed the least tannin. Leather tanned with hemlock is solid, while that tanned with à la garouille appears soft. Müntz and Schön raise the question why equal quantities of tannin give such different results, and answer that in tanning with hemlock a certain quantity of resinous substances are introduced into the interior of the leather which cannot be removed by washing with ether and alcohol, and make the fibre brittle.

Leather tanned with chestnut bark and quebracho furnishes, it is claimed, as good a quality as that with oak bark, and at the same time a greater increase in weight. As the tannin contained in these materials costs scarcely half as much as oak tannin, the use of chestnut and quebracho would be of advantage.

Müntz and Schön also draw attention to the fact that leather tanned with oak bark kept three years in the pit contained, after washing with ether and alcohol, 2 per cent. less tannin than that tanned with oak bark two years in the pit. This phenomenon, they say, may possibly be caused by the skins differing in their interior condition and possessing a greater or smaller absorbing power.

The question whether a skin by continued remaining in the tanning material can absorb larger quantities of tannin, Müntz and Schön answer by saying: "The skin does not absorb an unlimited quantity of tannin; there comes the moment of saturation." In the opinion of these two chemists the quality of the leather is not improved by its remaining for a long time in the pit.[1]

[1] For portions of the matter in this chapter the author desires to acknowledge his indebtedness to the Dictionnaire de Chimie Pure et Appliquée, Wurtz, and to Bolley's Technolgie 35 (Bd. vi. 4), Lederbereitung, Heinzerling.

CHAPTER VII.

MINERAL AND ARTIFICIALLY PREPARED TANNING SUBSTANCES.[1]

SECTION I. MINERAL TANNING MATERIALS.

THE use of mineral tanning materials dates back to very remote times, since history teaches us that the Saracens used alum and aluminium salts for tanning skins. These substances were in fact for a long time the only tanning materials employed for preparing leather, a series of other mineral substances for tanning having been only recently introduced as a substitute for vegetable substances.

The principal mineral substances we have to consider are:—

1. *Alum*, *aluminium sulphate*, and *aluminium acetate.*
2. *Chromates* and *chromic oxides.*
3. *Ferric salts.*
4. *Common salt.*

Aluminium Sulphate.

Neutral aluminium sulphate ($Al_2 3SO_4$) is prepared either by treating clay or bauxite with concentrated sulphuric acid, or from cryolite. In an anhydrous state it contains 30 per cent. of alumina and 70 per cent. of sulphuric acid. With eighteen equivalents of water it crystallizes into octahedrons, or at a temperature of 32° F. into hexagonal rhombohedrons. Aluminium sulphate is soluble in double its weight of water. A solution prepared with the assistance of heat separates, on cooling, crystalline lamina of aluminium sulphate ($Al_2 3SO_4 + 18H_2O$). It is found in commerce in a nearly pure state, the best qualities containing only traces of iron, but from 0.5 to 2

[1] Bolley's Technologie, 35 (Bd. vi. 4), Lederbereitung, Heinzerling.

per cent. of free sulphuric acid,[1] which is frequently injurious when the salt is to be used for tanning purposes. The presence of free sulphuric acid may also be detected by adding to a solution of aluminium sulphate some logwood tincture. The solution, if free acid is present, will be colored brown-yellow, and deep violet, if it is neutral. To make aluminium sulphate containing free sulphuric acid available for tanning purposes, add to a solution of it 1 to 2 per cent. of zinc chips, the solution of which will be attended by a violent development of hydrogen. By the free sulphuric acid combining with the zinc, zinc sulphate is formed. An excess of zinc is dissolved with formation of zinc sulphate and separation of basic sulphate of alumina. Instead of zinc chips 1 to 2 per cent. of sodium carbonate may be used.

Aluminium sulphate, known in commerce as concentrated alum, is used in tanning as a substitute for alum. The skin absorbs, according to Knapp, up to 27 per cent. of it, which is removed by washing with water.

Alum ($Al_23SO_4+K_2SO_4+24H_2O$), is formed by the combination of aluminium sulphate with alkaline sulphates. It is readily prepared by mixing solutions of the two sulphates. In evaporating the fluid, the alum crystallizes out. Potash-alum and ammonia-alum dissolve with difficulty, they requiring 18.4 parts of cold water and 7.5 parts of boiling water, while soda-alum dissolves readily. From a hot saturated solution, the alum separates in octahedrons, and from alkaline solutions in hexadrons. The last variety is called in commerce cubic alum, and, being nearly free from iron, is valued more highly than the former. Alum has at first a sweetish taste which changes into an astringent. By heating it loses gradually its water of crystallization, becomes anhydrous, and is converted into the so-called burned alum. Ferric sulphate, manganous sulphate, and chromium sulphate, which are isomorphous with aluminium,

[1] To test aluminium sulphate for free sulphuric acid, compound, according to Edward Donath, a solution of it at an ordinary temperature with a few drops of potassium iodide and potassium bichromate and add a little bisulphate of carbon. If free acid is present the iodine is liberated and the bisulphide of carbon, on shaking, assumes a beautiful violet color.

form also double salts when combined with potassium, sodium, or ammonium sulphate. The resulting combinations are called iron alum, chromium alum, and manganese alum. Instead of alumina they contain ferric oxide, chromic oxide or manganic oxide. They crystallize in the same form, and contain an equal quantity of water of crystallization:—

Iron alum $= Fe_23SO_4 + K_2SO_4 + 24H_2O$.

Manganese alum $= Mn_2 3SO_4 + K_2SO_4 + 24H_2O$.

Chromium alum $= G_2 3SO_4 + K_2SO_4 + 24H_2O$.

If several of these alums in solution are present in one fluid, the crystals separating from it contain the different bases in varying quantity. It is due to this circumstance that alumina alum contains frequently iron alum, which it is often impossible to remove even by repeated recrystallization. In tawing and in mineral tanning potash-alum is principally used.

For a complete saturation the skin tissue absorbs, according to Knapp, 7 to 8 per cent. of alum.

The tanning properties of alum are principally due to the alumina salts it contains.

In absorption by the skin tissue, the alum, according to Knapp and Raimer, is split, the aluminium sulphate or basic aluminium sulphate precipitating upon the fibre, while the potassium sulphate remains in the liquid. In the presence of common salt in aqueous solution, the alum, according to Knapp, is not converted into aluminium chloride and sodium sulphate.

Iron and chromium alum act upon the skin tissue in the same manner as aluminium alum.

Aluminium acetate ($Al_26(OC_2H_3O)$) is prepared by dissolving alumina in acetic acid or compounding lead acetate with aluminium sulphate or alum. Heating during the process should be avoided. Experiments have lately been made in using aluminium acetate in place of aluminium sulphate or alum.

It does not separate, it is claimed, in a crystalline form in the skin, and the leather tanned with it does not become spotted, as is frequently the case in tanning with alum. The tanning with this salt is more solid than with alum, since the aluminium acetate decomposes more or less in the leather by the formation of basic salts or free alumina.

A further advantage claimed for aluminium acetate is the absence of free sulphuric acid, which is split off from the aluminium sulphate and exerts a very injurious influence upon the leather.

Chromium Salts.

Experiments have only been made within the last three or four years to use chromates mixed with alumina salts for tanning in place of vegetable substances.

The most important for this method of tanning is the *potassium bichromate* from which all other chromic salts and compounds of chromium used for technical purposes are derived. The salt is chiefly manufactured in three large establishments in England, from whence it is sent to all parts of Europe and partly to America. It is made by roasting a mixture of finely powdered chrome iron-stone with potassium carbonate upon the hearth of a reverberatory furnace for several hours with constant stirring of the mass. The chromium oxide is oxidized to chromic acid, the latter combining with the potassium to potassium chromate. The ferric oxide contained in the chrome iron-stone is separated as such. After thorough oxidation the roasted mass is lixiviated with water, whereby potassium chromate, a small excess of potassium carbonate and a few impurities, such as potassium silicate, pass into solution. The liquid is allowed to clarify by standing, and, after decanting, is evaporated if necessary, and the neutral potassium chromate converted into potassium bichromate by adding the required quantity of sulphuric acid. The potassium bichromate forms large bright garnet-red trichinic crystals. It is soluble with difficulty in cold water.

20	parts	of	water	at 32°	F.	dissolve	1	part	of the salt.
11.8	"	"	"	50	"	"	1	"	"
7.65	"	"	"	68	"	"	1	"	"
1.18	"	"	"	140	"	"	1	"	"

Potassium bichromate is very sensitive. With glue, gelatine, gum, etc., it forms combinations which, after exposure to light, are insoluble in water, its employment in photography for

preparing pigment or carbon pictures depending upon this property.

It precipitates itself upon the skin fibre, and partly penetrates it.

Taken internally it has a poisonous effect like most metallic combinations. Placed repeatedly upon excoriated or sore places it produces running ulcers, which are, however, soon healed by washing with lead vinegar. It colors the sound cuticle yellow without destroying it. In pulverizing potassium chromate care must be had not to allow the powder to enter the nostrils as it produces violent itching and severe spells of sneezing.

Sodium bichromate is more soluble in cold water than potassium bichromate, but as it crystallizes with difficulty and does not form an article of commerce, it is but little used.

Calcium bichromate, strontium, and barium are soluble in water, while the neutral chromate of calcium, strontium, and barium are soluble with difficulty, the barium salt, which forms a well-known art color, being almost insoluble in water. Lead salts give with chromic salts insoluble precipitates which are used as painters' colors.

The neutral alkaline chromates are yellow, readily soluble in water, and can be used in place of the alkaline bichromates, but being dearer than the latter offer no advantage.

Chromium alum is the most important of the chromium salts thus far introduced in tanning. It is prepared by mixing chromium sulphate with alkaline sulphates. It crystallizes from the fluid in octahedrons.

In speaking of alum, it has been mentioned that chromium alum acts upon the fibre in the same manner as aluminium alum, but the tanning of leather prepared with aluminium alum being, as we will see later on, more perishable on exposure to water than that of leather prepared with chromates, the latter are preferred.

Chromic sulphate ($Cr_2 3SO_4$) is obtained by reducing chromic acid to chromic oxide, and dissolving in sulphuric acid. It is soluble in water, giving to the latter an emerald-green color, and has the same tanning effect upon the skin fibre as aluminium sulphate.

Ferric Salts.

Tanning with ferric salts was already recommenced in the last century by D'Arcet. Bordier, in 1842, obtained a patent for tanning by means of ferric sulphate obtained by oxidizing ferrous sulphate.

In modern times Knapp has attempted to reintroduce in practice the method of tanning with ferric salts. The ferric sulphate used by him is also prepared by oxidizing ferrous sulphate with nitric acid, the latter being added to a solution of the former until effervescence ceases and all the ferrous oxide is converted into ferric oxide. After the cessation of the first effervescence ferrous sulphate is again added until effervescence ceases, the object of this addition being to reduce any excess of nitric acid used. The resulting basic ferric sulphate solution should be of a syrupy consistency, and contain chiefly basic ferric sulphate and a small excess of ferrous sulphate.

Prof. Knapp says that only basic ferric sulphate prepared in the above manner is adapted for tanning on account of its amorphous condition and beautiful brown-yellow color and the indecomposableness of its aqueous solution in boiling. The commercial basic ferric sulphate, according to Knapp, does not give a syrupy solution, is of a much darker color, and the aqueous solution is decomposed by boiling.

This ferric salt is, according to Knapp, abundantly absorbed by the skin tissue and effects a complete tanning of the skin fibre. It is claimed that the salt absorbed by the skin cannot be removed by treating with water.

By precipitating a soap solution with the above basic ferric sulphate, Prof. Knapp prepares an *iron soap* which is a combination of ferric oxide with sebacic acids. This, to complete the tanning process, is mechanically fulled into the skin, either by itself or mixed with fat solutions or emulsions.

Common Salt

occupies an important place in tanning. It serves, as has been previously mentioned, on the one hand for preserving skins, and on the other to accelerate the tanning process in tawing

and mineral tanning. As regards its occurrence, preparation, etc., nothing need be said.

The salt found in commerce is either rock salt or that obtained from salt springs or sea-water, the latter being known as common salt. Both varieties contain varying quantities of admixtures, the principal being the sulphates of magnesia, lime, or gypsum, and the chlorides of calcium and magnesium. Common salt prepared from sea-water contains the most impurities, the principal being magnesium chloride, magnesium sulphate, calcium chloride, etc. The salt obtained from rock salt by recrystallization being the purest is especially adapted for use in tanning.

In using common salt in tawing and mineral tanning, admixtures of magnesium chloride and calcium chloride are especially injurious as they absorb water from the air, *i. e.*, they are hygroscopic.

When salt containing these admixtures is used for tanning the leather produced with it absorbs water from the air and becomes moist.

SECTION II. ARTIFICIALLY PREPARED TANNING SUBSTANCES.

Many attempts have been made to substitute artificial tanning substances for those of a vegetable or mineral origin occurring in nature. Although they have thus far not been introduced in practice we will briefly describe the manner of preparing them.

Jennings patented in 1848 an artificial tanning material prepared in the following manner: Dense black peat is thoroughly dried and pulverized, and treated with 10 to 20 per cent. of concentrated nitric acid gradually added. The mass becomes hot in a short time and evolves yellow-red vapors of nitrous acid, the escape of which is partly prevented by covering the apparatus. When the action of the nitric acid has ceased, six to ten times the quantity of water of acid used is added, and the whole heated for a few hours with frequent stirring, the object of heating being to accomplish the solution of the tannin formed by the action of nitric acid. In order to use peat re-

cently cut, it must be heated with steam to 176° to 212° F. before treating with nitric acid. The tannin dissolved in the fluid is freed from the coloring matter by adding a few per cent. of stannous chloride and boiling for a few minutes. The coloring matter is precipitated, after which the clear supernatant fluid is decanted off.

Aluminium sulphate and common salt can also be used for precipitating the coloring matter.

The skins to be tanned are immersed for a few hours in the tanning solution and frequently moved, and then placed for a few hours in an alkaline carbonate solution and also frequently moved, when they are replaced in the tannin solution, next in the alkaline solution, and so on until they are completely tanned.

Sky manufactures a similar tanning material (Wagner's Jahresberichte, 1867, 666).

Lees patented in 1858 the following method of preparing artificial tannin. The heavy oils obtained in the dry distillation of coal or bituminous shale are treated with concentrated sulphuric acid until a carbonaceous, resinous mass is obtained. To accelerate the action of the sulphuric acid upon the oily mass, the mixture of sulphuric acid and oil is indirectly heated with steam. The resulting black, pitchy mass is boiled with nitric acid and then compounded with ammonia, or ammoniacal liquor or some other alkali, until the acid is neutralized. An excess of alkali must be avoided, as it exerts a dissolving effect upon the pitchy mass. Lees calls the resulting product *mineral tan.* For tanning it is dissolved in water, and the skins are allowed to remain in intimate contact with the solution for some time, after which they are finished in a solution of alum or other salts.

Another kind of artificial tannin is formed by heating a solution of resins and camphor with sulphuric acid.[1] After some time the mass becomes black. By adding water a black powder is separated, the alcoholic extract of which on being evaporated leaves behind the artificial tannin. The chemical nature

[1] Muspratt, iii. 106.

of the tannins obtained by these processes can only be conjectured, since they have not been scientifically examined.

The tannins obtained by treating peat, brown coal, coal, etc., with nitric acid are very likely nitro-combinations of the aromatic series and possibly closely related to picric acid, for it is well known that by the action of nitric acid upon a series of organic substances yellow nitro-combinations are formed which are frequently considered as picric acid. Picric acid[1] in aqueous or alcoholic solution converts the skin into leather, but is not used in practice on account of its high price.

The tannins obtained by the action of sulphuric acid upon resins and camphor may possibly be sulpho-combinations of organic bodies, such as are frequently produced by sulphuric acid.

CHAPTER VIII.

CHEMICAL EXAMINATION OF VEGETABLE TANNING MATERIALS.

Most tanners determine, even at the present time, as has been done for hundreds of years, the quality of the tanning material by its appearance, taste, and odor. While with some experience it may be possible by these means to distinguish good bark from a bad article, they offer no guide for the finer distinctions in value.

That an absolutely accurate method of determining the tannic acid in the various tanning materials is wanting even at the present day, may be explained by the fact that, with the exception of gallotannic acid, we know next to nothing, in a chemical respect, of the different tannins.

As regards the properties and mode of distinguishing the tannins occurring in the various vegetable tanning materials, we refer to what has been stated in Chapter VI.

[1] Picric acid, $C_6H_2(NO_2)3HO$, is obtained by the action of nitric acid upon phenol, indigo, benzole, silk, wool, resins, etc. It forms pale yellow crystalline lamina, and is soluble with difficulty in water, but readily in ether or spirit of wine.

Method of Determining the Tannic Acid.

The quantity of tanning matters contained in the different astringent products used in industry has a valuable practical importance and a large number of methods have been proposed to reach this result in the most rapid and accurate way possible.

The areometer (tan-meter) is an instrument which has been used for some time to obtain an idea as to the strength of the tanning liquors, and the percentage of the bark. The percentage of tannic acid is estimated from the greater or smaller specific gravity of the aqueous solution of a determined quantity of tanning material. The richer the aqueous solution in tannic acid, the higher its specific gravity. This method furnishes inaccurate results, since the bark, according to its age and the soil upon which it is grown, contains varying quantities of other substances soluble in water, which affect the specific gravity of an aqueous solution. The following substances occur, according to Gerber, in an aqueous solution of the inside layer of oak bark:—

Tannin	8.05
Gallic acid	1.59
Sugar, Extractive substances, Malic acid	8.33
Rosin, Fat	6.31
Gum	5.60
Quercus red	2.34
Pectic acid	6.77

Davy first indicated a volumetric method founded on the precipitation of the gelatine with the tannin. To the aqueous extract of a known weight of astringent matter is added an excess of a solution of gelatine or isinglass (1 part of isinglass for 6 parts of the astringent solution). The precipitate gathered on the filter, washed, dried, and weighed, represents $\frac{4}{10}$ of its weight in tannin. The results thus obtained are very weak, as the precipitate of tannate of gelatine always passes partially through the filter. According to Müller, this inconvenience may be obviated by the use of a solution of gelatine containing some alum. In that case the precipitate separates completely,

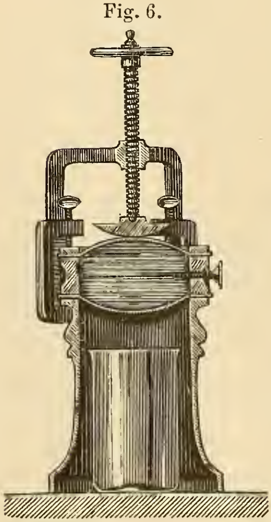
and Fehberg has even been able to found, on the use of aluminated gelatine, a process of volumetric denomination. The normal solution contains 10 grms. of air-dried gelatine per litre and 3 grms. of alum. This liquor is titrated by means of a solution of pure tannin containing 2 grms. per litre.

It is evident that this process can only be applied to the tannins which precipitate gelatine; but, as they are also those that enter into the composition of tanning matters, this restriction does not diminish the value of the process. One can judge of the termination of the reaction when a small quantity, taken for trial from the clear liquor and put in a testing vessel, does not sensibly become troubled by the gelatine or tannin.

Müntz and Rampercher[1] filter the tanning liquor under pressure through a moistened skin from which the hair has been removed, and weighed while dry.

By drying the skin later on at 212° F. they learn from the increase in weight the amount of tannic acid contained in the solution. They have constructed a small apparatus shown in Fig. 6.

Fig. 6.



The lower part serves as a support for a piece of prepared skin. When the apparatus is to be used, the upper part, which is provided with a long arm, is connected with the lower by means of clamp screws. The space between the piece of skin and the helmet of vulcanized rubber is sufficiently large to hold 100 c.c. of tanning liquor, the specific gravity of which has been previously determined by the areometer. The brass cover on the side is then screwed down tightly, and the liquor forced down upon the skin, which absorbs all the tannic acid, by the pressure of the perpendicular screw upon the rubber helmet. The water and other substances of the solu-

[1] Comptes rendus, lxxix. 380, and Ding. Polyt. Journ., ccxiv. 74.

tion run off into a glass vessel, and are tested as to their specific gravity with the areometer, the percentage of tannic acid being shown by the difference between the two gravities.

This apparatus is said to answer the purpose very well. It recommends itself at any rate by its simplicity and the quickness with which a determination of the tannic acid can be executed.

Fleck and Wolf's[1] method is based upon the precipitation of the tannin with a solution of cupric acetate, 100 parts of cupric oxide = 130.4 of tannic acid (Wolf[2]).

Persoz's method.—Risle Bennat[3] describes a process by Persoz, according to which the tannic acid is precipitated with stannous chloride solution, and its percentage estimated by measuring and comparing the precipitate, several measuring cylinders graduated into $\frac{1}{100}$ of parts being used for the purpose. A solution of tannic acid of a determined percentage is prepared by dissolving 10 grms. of dry pure gallotannic acid in water and diluting the solution to one litre. The stannous chloride solution is prepared by dissolving 8 grms. of stannous chloride and 2 grms. of sal ammoniac in 1000 c.c. of water. To determine the tannic acid, for instance in barks, 10 grms. of the latter are boiled in half a litre of water for half an hour. The decoction is filtered and the residue washed out with sufficient hot water to make the total quantity of the fluid equal to 1 litre. 100 c.c. of this solution are brought into the measuring cylinder by means of a pipette and slowly compounded with 100 c.c. of the stannous chloride solution. After settling for ten or twelve hours the amount of precipitate is read off from the scale of the cylinder.

A comparative experiment being made at the same time with the normal solution mentioned above, by adding to 100

[1] *Wagner*, Jahresberichte, 1861, 625.

[2] According to *Pavesi* and *Rotondi* 145 parts of tannic acid (Berichte der deutsch. chem. Ges. 1874, 590). *Schiff* explains these differences by the use of tannic acids of varying purity. By using pure tannic acid (*i. e.*, digallic acid $C_{14}H_{10}O_9$) 100 parts of cupric oxide would, according to *Schiff*, correspond to 136 parts of tannic acid.

[3] Zeitschr. f. analyt. Chemie, 1863, 287.

c.c. of it, a like quantity of stannous chloride solution, the percentage of tannic acid can be readily determined from the relative volumes of the two precipitates. If, for instance, 50 c.c. of precipitate are obtained with the normal tannic acid, and only 7 c.c. with the test fluid, the percentage of this substance, if 10 grms. were contained in 1 litre, would be $\frac{7 \times 100}{50} = 14$ per cent.

Grauhe advises especial care that the difference in the volumes of the precipitates is not too great. The extracts of the tanning materials should, if necessary, be concentrated, or the test acid diluted. The fluids must, of course, stand at an equal height in the cylinders.

To enable persons not possessing graduated cylinders to avail themselves of this method, Risle Bennat proposes the determination of the precipitate, previously washed out and dried by gravimetric analysis. By heating the precipitate with ammonium nitrate pure stannic oxide is obtained. The percentage of tannic acid is found by subtracting the amount of stannous oxide calculated from the stannic oxide (100 SnO_2 correspond to 89.33 SnO) from the previously found weight of the precipitate of stannous tannate. This method may be recommended for technical purposes, especially in cases where gallic acid occurs with tannic acid.

Wildenstein's[1] *colorimetric method* is based upon the coloring which strips of paper saturated with ferric citrate assume when dipped in a fluid containing tannic acid. Wildenstein claims that the percentage of tannic acid can be estimated by comparing the depth of the coloring with an empirically obtained color-scale.

Fehling's method[2] *modified by G. Müller.*[3]—This is based upon the precipitation of the tannic acid with titrated aluminated solution of glue. To prepare the glue solution 10 grms. of white bone glue are soaked in distilled water, and, after swelling, dissolved by moderate heating, 25 grms. of alum are then added

[1] Zeitschr. für analyt. Chemie, 1863, 137.

[2] Liebig and Kopp Jahresberichte, 1853, 683.

[3] Ding. Polyt. Journ., I. 51 to 69.

and the whole diluted to 1 litre. The titre of the glue solution undergoing quick alteration, it must every time be re-established to the normal tannin solution. 0.2 grm. of dry gallotannic acid requires for complete precipitation 22.7 c.c., 1 c.c. of this glue solution corresponding consequently to 0.0088 grm. of tannic acid. 5 grms. of the bark to be tested are boiled three or four times in 50–60 c.c. The resulting solution is filtered and diluted with water to 500 c.c. To 50 or 100 c.c. of this solution, glue solution is added from a burette, with constant stirring, until all the tannic acid is precipitated. The stirring is done, according to Hallwachs, with a glass tube open on both ends, with which, in the same manner as with a pipette, a sample is taken from the supernatant fluid and placed upon a small filter. To the filtered sample a drop of glue solution is added by allowing it to remain suspended in the upper part of the tube, which is held obliquely, and then rinsing it carefully with distilled water into the sample fluid. If the latter remains clear, the reaction is finished, but if it becomes turbid, the filtered sample and the filter are returned to the test fluid and more glue solution added to the latter from a burette. This is carefully continued until a small sample gives no turbidity with tannic acid nor with glue solution. Should turbidity be caused by tannic acid, an excess of glue solution has been added, necessitating a repetition of the test.

Satisfactory results are, according to Gauhe[1] and Hallwachs,[2] obtained by this method, but, on account of the tedious manner of execution, it is not suitable for easily making many determinations of tannic acid.

In place of white glue, Lippowitz[3] uses isinglass for precipitating the tannic acid. According to his statement 1 grm. of insinglass dried over sulphuric acid precipitates exactly 0.75 grm. of tannic acid, a solution of 1.333 grms. of isinglass sufficing consequently for the precipitation of 1 grm. of tannic acid.

Carpené-Barbieri's method is based upon the precipitation of the tannic acid with an ammoniacal solution of zinc acetate.

[1] Zeitschr. f. analyt. Chemie.

[2] Gewerbeblatt f. d. Grosshergogth, Hessen, 1845, 51 u. 52.

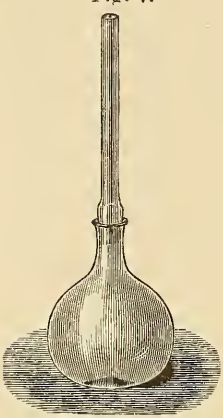
[3] Wagner Jahresberichte, 1861, 624.

One-third of the precipitated fluid is evaporated by boiling. The precipitate obtained is filtered, washed with hot water, and dissolved in dilute sulphuric acid. The insoluble substances are separated from the solution by filtering, and the filtrate tritrated with solution of potassium manganate. Kathreimer,[1] on subjecting this method to a closer examination, found the results obtained by it to be inaccurate.

Gerland's method[2] is based upon the precipitation of the tannic acid with tritrated solution of tartar emetic. Hallwachs[3] and Koller,[4] who have already had control of this method, are of the opinion that an accurate determination of the tannic acid can in no case be attained with Gerland's method.

Jeans's[5] *method* of determination is based upon the action of tannic acid and gallic acid to fix, in the presence of sodium carbonate, a proportional quantity of iodine. The extractive substances of oak bark, it is claimed, exert no disturbing influence whatever. If, besides tannic acid, gallic acid is present, two tritrations are required, one direct and the other indirect, after the tannic acid has been removed by means of animal skin or gelatine.

Fig. 7.



Picnometer.

Kathreiner, who tested this method, considers it as very tedious and requiring too much time. A further evil is the quick alteration of the titre of the iodine solution.

K. Hammer's method[6] is based upon principles coming closest to the true conditions in tanning, and furnishes, if in any way accurately executed, good corresponding results. Hammer determines the specific gravity of the fluid containing the tannic acid by means of a picnometer (Fig. 7) or,

[1] Dingl. Polyt. Journal, ccxxvii. 489.
[2] Chem. News, 1863, 54, Zeitschr. f. analyt. Chemie, 1863, 419.
[3] Dingl. Polyt. Journ., clxxx. 50.
[4] Neues Jahrbuch für Pharmacie, xxv. 206.
[5] Bericht d. deutsch. Chem. Gesellsch. 1877, 730.
[6] Journal f. prakt. Chemie, lxxxi. 156.

an areometer, which indicates the specific gravity to 1.0409. Next he precipitates the tannic acid from the fluid with especially prepared animal skin, and determines the specific gravity after precipitation. The difference in the two specific gravities is in proportion to the percentage of tannic acid.

To facilitate the calculation of the latter, the following table is used from which the relation between the specific gravity and the percentage of tannic acid of varying concentration can be seen.

Per cent. of tannic acid.	Specific gravity at 59° F.	Per cent. of tannic acid.	Specific gravity at 59° F.	Per cent. of tannic acid.	Specific gravity at 59° F.
0.0	1.0000	1.7	1.0068	3.4	1.0139
0.1	1.0004	1.8	1.0072	3.5	1.0140
0.2	1.0008	1.9	1.0076	3.6	1.0144
0.3	1.0012	2.0	1.0080	3.7	1.0148
0.4	1.0016	2.1	1.0084	3.8	1.0152
0.5	1.0020	2.2	1.0088	3.9	1.0156
0.6	1.0024	2.3	1.0092	4.0	1.0160
0.7	1.0028	2.4	1.0096	4.1	1.0164
0.8	1.0032	2.5	1.0100	4.2	1.0168
0.9	1.0036	2.6	1.0104	4.3	1.0172
1.0	1.0040	2.7	1.0108	4.4	1.0176
1.1	1.0044	2.8	1.0112	4.5	1.0180
1.2	1.0048	2.9	1.0116	4.6	1.0186
1.3	1.0052	3.0	1.0120	4.7	1.0190
1.4	1.0056	3.1	1.0124	4.8	1.0194
1.5	1.0060	3.2	1.0128	4.9	1.0198
1.6	1.0064	3.3	1.0132	5.0	1.0202

Franz Schulze[1] has modified this method by adding 10 grms. of white glue to a concentrated solution of sal ammoniac and diluting to 1 litre by a further addition of pure solution of sal ammoniac. 10 grms. of gallotannic acid are, in the same manner, dissolved in concentrated sal ammoniac and the solution diluted to 1 litre. The addition of sal ammoniac is claimed to facilitate the settling of the precipitate. The bark extract is saturated with sal ammoniac, and, after compounding with a teaspoonful of white sand or glass powder, the glue solution is gradually added, with constant stirring, until the formation of the precipitate is more and more plainly observed. The nearer the point of saturation is approached, the quicker, by allowing

[1] Dingl. Polyt. Jour. clxxxii. 155, bis 158.

the mixture to stand quietly, is the sediment shown, until the precipitation takes place inside of half a minute, and the fluid appears clear.

Salzer,[1] who tested Schulze's method, remarks that with some experience it is easily and quickly executed, but as the precipitate, though separating itself readily, floats on top if the fluid contains too much sal ammoniac, he recommends the use of a less concentrated solution of sal ammoniac.

In executing Hammer's method, it must first of all be observed, that the tannic acid to be determined, is obtained from the substance in as concentrated a solution as possible, because if the difference in the specific gravities is greater before and after precipitation, the error of observation is smaller. 20–30 grms. of the substance are boiled with 50–60 c.c. of water for 30 to 40 minutes, the water lost by evaporation being constantly replenished, and then completely exhausted with five to six times the quantity of hot water, and filtered. The clear filtrate is weighed and reduced to a round number of 350 to 400 grms. After cooling, the specific gravity of the fluid is determined either with the picnometer or the areometer, all precautions required for such operations being of course used.

Sufficient test fluid to fill the picnometer or a cylinder in which the areometer is to be immersed is weighed off in a matrass which may be either dry or previously rinsed out with fluid containing tannic acid, and then four times the quantity of tannic acid, found by a preliminary determination from the specific gravity, of unhaired animal skin is added. The latter is best prepared in the following manner: A piece of skin prepared for tanning by freeing it from hair, lime, etc., is placed in running water for several hours, then stretched upon a clean board, and after drying converted into powder with a coarse rasp.

The powder can be kept in a hermetically closed flask for some time. Before use it is soaked in cold water for a short while, then thoroughly pressed out in a linen cloth between the hands to prevent the adhering water from changing the specific

[1] Zeitschr. f. analyt. Chemie, 1868, 70.

gravity of the fluid containing tannic acid. After adding the skin powder to the fluid, the matrass is closed and shaken for some time.

An approximate weighing of the fluid and skin powder only is required. After the precipitate has settled, the supernatant fluid is poured off through a fine cloth either directly into the measuring cylinder or into the picnometer, and the specific gravity determined.

Special areometers have been constructed for practical use, which show directly the quantity of tannic acid by the difference in the specific gravity. The graduation of this areometer is according to degrees or per cents. Suppose a solution of tanning material shows before precipitation 5.5 per cent. and after precipitation 1.5 per cent., the amount of tannin would be 4 per cent.

But if the percentage of tannin is to be calculated from the specific gravity found by means of the areometer or picnometer, the following example may serve for an illustration :—

30 grms. of bark have been exhausted with 350 grms. of water. The specific gravity which was 1.01 at 59° F., indicated 2.5 per cent. of tannin. After precipitation with skin powder and filtering, the specific gravity was 1.006=1.5 per cent. of tannin. The difference between the two determinations being 1 per cent., the fluid is a 1 per cent. one, and the 350 grms. consumed contained 3.5 grms. of tannin. As the latter were contained in 30 grms. of bark, the calculation (30 : 3.5 : : 100 : x) gives 11.66 per cent. as the amount of tannin contained in the bark.

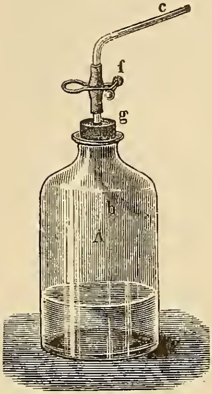
Mittenzwei[1] and *Terreil's*[2] *method* is based upon the well-known property of tannic acid and allied substances to absorb, when in alkaline solution, oxygen. The quantity of tannic acid is calculated from the amount of oxygen absorbed in the presence of potash, and they use for the determination a graduated testing tube of special form and arrangement.

[1] Journ. f. prakt. Chemie, lxi. 61.

[2] Comptes rendus, lxxviii. 790.

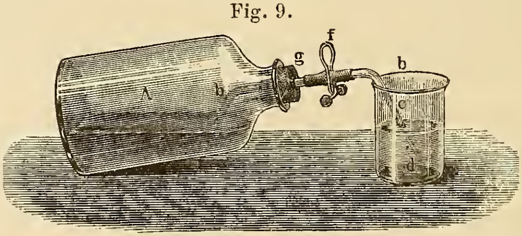
This method, which, according to the statements of the authors, is also adapted to the determination of ferrous oxide, manganesous oxide, and indigo, is executed in the following manner:—

Fig. 8.



The air in a flask having a capacity of 1 litre (Fig. 8) communicates with the atmosphere by means of the bent glass tubes *b* and *c*, the upper part of the latter narrowing to 1.5 to 1 millimeter. The connection of the two glass tubes is effected by means of a moderately long rubber tube provided with a compression stopcock. The tubes pass into the flask through a hole in the cork, or, better through a rubber stopper. Before commencing the operation, the air in the flask and all fluids to be used should have the same temperature as the working room, one of 59° F. being the best. The flask *A* is then filled with 200 c.c. of 3 to 5 per cent. solution of potash or soda lye to which is added 1 grm. of tannic acid wrapped lightly in paper. After placing the cork firmly in the flask, the compression stopcock is opened for a moment in order to place the inclosed air under the pressure of the atmosphere, the absorption of oxygen being facilitated by frequent shaking. An increase in the temperature of the flask

Fig. 9.



is prevented by wrapping a cloth around the hand. After shaking the flask several times, water is drawn in through the aperture *d*, of the pipe *c*, from a weighed beaker glass *b*, by opening the compression stopcock *f* (Fig. 9).

The experiment is finished when, after frequent shaking, no more absorption takes place. The grammes of water entering the flask from the beaker glass which are found from the difference in the weight of the beaker glass before and after the operation, indicate the number of cubic centimeters of oxygen absorbed, which can be readily reduced to a temperature of 32° F. and 29.922 inches pressure by the well-known formula. 1 grm. of tannic acid and 1 grm. of gallic acid absorb, according to Mittenzwei, 175 c.c. of oxygen, and, according to Terreil, 200 c.c. The great difference in these statements, which would make this method, otherwise simple and practical, appear inaccurate, is very likely due to the different degrees of concentration of the alkaline solutions used, as, according to Mittenzwei, 1 grm. of tannic acid in 200 c.c. of potash lye of 35 per cent. KOH, absorbed, after continued and rigorous shaking, not more than 22 c.c. of oxygen. This interesting fact deserves closer investigation.

We will further mention that Terreil, in modifying Mittenzwei's method, and using a concentrated 30 per cent. potash lye, in place of dilute solution, found that, by extending the duration of the action to twenty-four hours, a larger quantity of oxygen was absorbed.

The calculation of the result is very simple. Suppose 140 grms. of water have been drawn from the beaker glass into the flask, they would correspond to 140 c.c. of oxygen. If a more accurate result is desired, this volume is reduced to 32° F., and 29.922 inches pressure with a simultaneous consideration of the tension of steam.

As, according to Mittenzwei, 175 c.c. of oxygen correspond to 1 grm. of tannic acid, the amount of tannic acid found by calculation ($175 : 140 :: 1 : x$) will be 0.8 grm.

In the presence of tannic and gallic acid, Mittenzwei proposes the precipitation of the first by depilated skin, to place the filtrate in the absorbing flask, to add 3 to 4 per cent. of potassium or sodium hydrate, and determine the gallic acid in the above manner. If the total quantity by absorption of oxygen in the flask has been previously determined, the percentage

of tannic acid is found from the difference in the two determinations.

It is recommended to make a preliminary experiment in order to approximately calculate from it the quantity of substance fixed by 175 c.c. of oxygen. It is an open question whether the tannins derived from various substances absorb, under equal conditions, a like quantity of oxygen.

As the property of absorbing oxygen in alkaline solution is possessed by tannic acid in common with a series of other organic substances, it still remains to be determined, whether such substances as pectine, etc., which generally accompany tannic acid, would not also become more highly oxidized, and the found percentage of tannic acid, in consequence of this, be too high.

Hallwachs, who compared Mittenzwei's with various other methods, found at least that the result obtained by it was more than 1 per cent. too high.

Terreil, who used the same process, found, as previously mentioned, that 0.1 grm. of tannic acid absorbs 22 c.c. of oxygen. The absorption is complete only after twenty-four hours. Terreil executes the experiment in a tube divided into cubic centimeters, and provided on one end with a glass faucet and hermetically closed on the other end with a glass stopper 0.1–0.2 grm. of the substance to be examined, and 20 c.c. of a 30 per cent. potash lye are placed in a tube, and allowed to react for twenty-four hours, with frequent shaking. The tube is then opened in a beaker glass filled with water, and the absorption taking place observed, the percentage of tannic acid being calculated from the latter.

Although this method is rendered inconvenient by the necessity of taking into consideration the conditions of temperature and pressure of air, it deserves to be thoroughly tested to make it available in the future.

Grassi's Method.—Grassi[1] proposes the precipitation of the tannic acid with barium hydrate as barium tannate, to separate from the latter the barium by means of sulphuric acid, and to

[1] Bericht der deutsch. chem. Gesellsch. 1875, 254.

determine the tannic acid by titration with potassium permanganate. This method requires to be further perfected.

Wagner's Method.—*Wagner*[1] first divided, as previously mentioned, the various tannins into pathological and physical. The latter only being of value to the tanner, he endeavored to determine them by a simple method. As in his opinion the pathological tannic acid or tannin obtained from gall-nuts, which was formerly employed for making the titre, could not be used as a basis for the determination of the physiological tannic acid, he endeavored first to determine the atomic weight of the latter. He chose for this purpose tannic acid obtained by boiling the inside layer of oak bark. He precipitated the bark extract with sulphate of cinchonin, converted the resulting precipitate into tannate of lead by boiling with acetate of lead, and decomposed the tannate of lead into tannic acid and lead monosulphide by means of sulphuretted hydrogen. The tannic acid contained in the solution was once more precipitated with cinchonin solution, the precipitate washed and dried, and, after weighing, suspended in water, and compounded with potassium permanganate, added drop by drop, until the tannic acid was entirely destroyed. To this fluid was then added sulphuric acid, in order to convert the cinchonin contained in it, into sulphate of cinchonin. The latter was dried at 248° F., and weighed as neutral sulphate of cinchonin. By assuming the atomic weight of cinchonin as 308, Wagner found that of quercitannic acid as 813. For the precipitation of 1 grm. of quercitannic acid, 0.3715 grm. of cinchonin, equal to 0.4523 grm. of sulphate of cinchonin, is required. Besides cinchonin, which is chosen as being considerably cheaper, quinine, morphine, strychnine, etc., may be used for the purpose. Sulphate of cinchonin purified by recrystallization is of a constant composition. An admixture of cinchonidine, both bases being isomeric, is not injurious.

To execute the determination, Wagner dissolves 4.523 grms. of sulphate of cinchonin in 1 litre of water. As an indicator he uses acetate of roseaniline, of which he adds 0.08–0.1 grm. to the

[1] Dingl. Polyt. Jour., clxxxiii. 227.

above fluid. In connection with the cinchonin solution, the aniline red indicates the end of the precipitation of tannic acid by coloring the fluid beneath the precipitate red. 0.061 cubic inch of the mentioned cinchonin solution is equal to 0.1 grm. of tannic acid. It is of advantage to add before the experiment 0.5 grm. of sulphuric acid, as this accelerates the settling, and makes the precipitate less soluble. Wagner used for his determinations 10 grms. of the substance containing tannic acid, and after boiling with water for some time and filtering, diluted the obtained solution to 500 c.c. To 50 c.c. of this solution, which were equal to 1 grm. of the substance used, he added cinchonin solution from a burette, until the fluid above the flaky precipitate ceased to be turbid, and assumed a slightly reddish color.

Although with some experience a conclusion as to the completeness of the precipitation can be drawn from the condition of the precipitate, and the facility with which it settles, it is always best to make controlling experiments. The precipitates consisting of tannate of cinchonin are collected, and, after a considerable supply of them has been obtained, boiled with acetate of lead and water, until the reddish coloring of the precipitate is changed into a brown, and all the cinchonin has passed into solution. The excess of lead is separated from the hot filtered solution by means of sulphuric acid, and neutral sulphate of cinchonin obtained from the fluid freed of lead sulphate by evaporation with an addition of sulphuric acid.

Büchner,[1] who subjected Wagner's method to a thorough test, remarks that in order to observe the approach of the final reaction by the quick or slow settling of the precipitate, the manner of shaking the bottle exerts a material influence. He recommends it to be done with a horizontal, circular motion, which will effect the settling of the precipitate in five to eight minutes, so that the supernatant fluid will be perfectly clear, and can be readily judged as regards coloring. Many experiments have convinced Büchner of the futility of adding less than 0.2–0.3 c.c. of cinchonin solution, since 0.1 c.c. of it ex-

[1] Dingl. Polyt. Jour. clxxxiv. 334.

erts no perceptible effect upon the final reaction. In case the precipitate settles with difficulty, which is frequently the case with barks containing a high percentage of tannin, several samples are taken from one and the same decoction. To one of the samples 2 c.c. are added and allowed to settle quietly, to another one 4 c.c., to a third 6 c.c., to a fourth 8 c.c., and observed after some time to see which sample is precipitated. If the third sample, which contained only 6 c.c., is not ready, while in the fourth, which contained 8 c.c., the final reaction has been exceeded, only 7 c.c. are added to a fifth sample. The determination can be quickly and accurately executed in this manner. As regards Büchner's experiments in order to study the behavior of sulphate of cinchonin and other substances, used for the determination of tannic acid towards pectine substances, which generally accompany tannic acid, we refer the reader to the original essay, but will remark here, that according to these experiments, sulphate of cinchonin, solutions of glue, and alum produced by themselves no precipitation of pectine substances, while the results obtained according to the Persoz and Fehling-Müller method, were more or less too high.

Neubauer, who in his treatise, "Die Schälung der Eichenrinden"[1] (Wiesbaden, W. Kreidel), criticizes Wagner's method of determining the atomic weight of quercitannic acid, shows the incorrectness of the atomic weight found by Wagner, and comes to the conclusion that Wagner's method is not available in its present form, as the results obtained by it are too low.

Clark has modified Wagner's method as follows: To a solution of tanning material is added an excess of solution of sulphate of cinchonin (4.523 grms.) of the salt, 0.5 grm. of sulphuric acid, and 1 litre of water. The solution is filtered, washed out, and the residue determined with mercuric iodide (13.546 grms.) of mercuric chloride, and 49.8 grms. of potassium iodide to 1 litre of water. The amount of tannic acid is calculated from the difference by subtracting from the cinchonin solution first used the quantity added in excess which is found by

[1] "Stripping of Oak Barks."

retitration with solution of mercuric iodide. 1 c.c. of cinchonin solution precipitates 0.01 grm. of tannic acid, and 1 c.c. of solution of mercuric iodide is required to precipitate the cinchonin from 2.74 c.c. of cinchonin solution. This process cannot be recommended on account of the final reaction, as in all precipitating, analyses being very uncertain.

Loewenthal's Method modified by Neubauer.[1]—This is the most important of all the methods for determining tannic acid, as, when correctly executed, it furnishes results which always agree, and besides the process is easy and sure. It has been known for a long time that tannic acid in aqueous solution is readily oxidized by substances yielding up oxygen, as for instance, by solution of calcium chloride, or alkaline solution of potassium ferridcyanide, and especially by potassium permanganate.

A dilute solution of the latter was first used for precipitating tannic acid by Monier,[2] who added it until the fluid assumed a red color by an excess of it.

Loewenthal[3] showed that the tannic acid in the presence of indigo solution is so completely destroyed, that with the disappearance of the blue color, the last trace of the tannic acid present is also decomposed, this being a sure and easy guide for the determination of the final point of reaction.

For the execution of the process are required :—

1. An indigo solution prepared by dissolving, with frequent shaking, 30 grms. of pure indigo carmine paste in 1 litre of water. The solution is filtered into bottles having a capacity of about 8½ ozs., which, after careful closing, are heated in a water-bath to 158° F. for one hour. By heating to this temperature the formation of mycelium in the indigo solution is prevented, making the latter available for a long time. Only pure indigo carmine, especially free from indigo red, should be used for this solution, as otherwise the final point of reaction is difficult to determine on account of the reddish or brown shade appearing towards the close. If, on the other hand, the solu-

[1] Zeitschr. f. analyt. Chemie, 1871, 1.
[2] Comptes rendus, xlvi. 44.
[3] Journ. f. prakt. Chemie, lxxxi. 150.

tion of indigo carmine is pure, the greenish color appearing finally passes suddenly over into a pure golden yellow.

2. A tannin solution. Chemically pure tannin is dried at 212° F. for a few hours, and 2 grms. of it dissolved in 1 litre of water. As the tannic acid should be as pure as possible in order to obtain accurate results, it is first tested by Hammer's method. 3 grms. of the tannic acid dried at 212° F. are for this purpose dissolved in 250 c.c. of water, and the specific gravity determined with a picnometer. The tannic acid contained in 150 c.c. of this solution is precipitated with some green depilated skin, the specific gravity is again determined, and the tannic acid calculated as previously mentioned. To make the tannin solution, which is very much inclined to mould, durable, it is filled into small bottles having a capacity of about $\frac{1}{2}$ oz. which are heated in a water bath to 158° F., and preserved lying on their sides.

3. A solution of potassium manganate. This should be of such concentration that 12–14 c.c. of it will decolorize 20 c.c. of the indigo solution, and 9–10 c.c. effect the destruction of the tannic acid in 10 c.c. of the solution containing 0.2 per cent. of tannic acid. 1 c.c. of potassium manganate solution oxidizes consequently 0.0020–0.0022 grm. of tannic acid. Such solution is obtained by dissolving 10 grms. of pure dry crystallized potassium permanganate in 61 grms. of water.

4. A $\frac{1}{10}$ normal solution of oxalic acid. In case sufficiently pure tannic acid cannot be obtained a $\frac{1}{10}$ normal solution of oxalic acid prepared by dissolving 6.3 grms. of pure crystallized oxalic acid in 1000 c.c. of water, can be used for making the titre for the solution of potassium manganate. By comparative experiments, Neubauer found that 6.3 grms. of oxalic acid are equivalent to 4.157 grms. of tannic acid.[1] To preserve the

[1] About 100 c.c. of tannin solution = 0.02 grm. of tannic acid were, after adding 20 c.c. of indigo solution, titrated with potassium manganate solution, four determinations requiring, on an average, 7.1 c.c. of potassium manganate solution, 1 c.c. of the latter being therefore equal to 0.002817 grm. of tannic acid. 10 c.c. of the normal solution of oxalic acid required 14.6 c.c. of the same solution of potassium manganate, 0.063 grm. of oxalic acid being, therefore, equal to 0.04118 grm. of tannic acid. Three experiments gave, on an

oxalic acid from decomposition by fungus vegetation, it is heated in well-closed bottles to 158° F. for a few hours.

5. Pure animal charcoal. Finely pulverized animal charcoal is completely extracted with hydrochloric acid and then washed with water by decantation until the reaction of chlorine disappears from the wash water. The animal charcoal thus prepared is preserved in a closed bottle under water.

6. Pure dilute sulphuric acid. *Making the titre.*—The relations between indigo solution and potassium manganate solution are first determined by compounding 20 c.c. of indigo solution with 700 c.c. of water and 10 c.c. of dilute sulphuric acid, placing the beaker glass containing the fluid upon a white support—a white porcelain plate—and adding, with constant stirring, solution of potassium manganate until the solution, in the commencement deep blue, becomes first dark green, then pale green, next greenish-yellow, and finally golden-yellow. The addition of solution of potassium manganate must be made very carefully towards the end of the reaction, and the fluid thoroughly stirred after adding a few drops, as otherwise the final reaction may be easily exceeded. With good indigo the transition from the greenish into the pure golden-yellow shade is quite sudden. After determining the consumption of solution of potassium manganate for 20 c.c. of indigo solution, the experiment is repeated with an addition of 10 c.c. of solution of tannic acid, 20 c.c. of indigo solution, 700 c.c. of water, 10 c.c. of sulphuric acid, and 10 c.c. of solution of tannic acid.

From the number of cubic centimeters of solution of potassium manganate consumed, is deducted the quantity required for 20 c.c. of indigo solution, and then is found the number which was required by the 10 c.c. of solution of tannic acid. The effective value of 1 c.c. of solution of potassium manganate can be readily calculated by simple division. To control and

average, 0.063 grm. of oxalic acid = 0.04157 grm. of tannic acid. By taking, according to Strecker, the molecular weight according to the formula $C_{27}H_{22}O_{17}$ as 618, 15 molecules of $C_2H_2O_4$, are according to the above determinations = 2 molecules of tannic acid. 63 grms. of oxalic acid are equal to 41.20 grms. of tannic acid, while the practical experiment mentioned above gave 41.57 grms. of tannic acid.

affirm the result, the experiment is twice repeated. Care must be had that the indigo solution is so concentrated that 20 c.c. of it require at least as much solution of potassium manganate as 10 c.c. of solution of tannic acid, or, what is surer, one-half more than the latter. The titre of the solution of potassium manganate must be frequently controlled.

Where gallic acid appears in connection with tannic acid, Loewenthal's method as modified by Neubauer cannot be used. Loewenthal[1] has, therefore, altered his method in the following manner:—

He makes two titrations, the first with the "original" solution of the tanning material and the second with "the fluid freed from tannic acid by precipitation with glue or skin powder." The difference gives the quantity of potassium manganate consumed for the tannic acid.

The glue solution is, according to Loewenthal, prepared by soaking 25 grms. of the finest Cologne glue in water over night, liquefying it the next day in a water-bath, saturating it completely with pure common salt and diluting with saturated solution of common salt to 1 litre.

Kathreiner,[2] who subjected this method to a thorough test, gives the following description of a suitable manner of executing it:—

The solution of potassium manganate used for titration is prepared by dissolving 1.333 grm. of crystallized potassium permanganate in 1 litre of water. The strength of the indigo solution used by Kathreiner and Loewenthal, is considered by them as exerting no influence upon the result. The concentration of the solution used by Kathreiner was such that 20 c.c. of it required for oxidization an amount equal to 9–10 c.c. of potassium manganate. The only thing of importance is that the quantity of indigo used in titration requires at least 1.5 times the quantity of potassium manganate of that which is necessary for the oxidation of the oxidizable substances to be determined. The quantity of indigo solution to be added to the extract of

[1] Zeitschr. f. analyt. Chemie, 1877, 33, u. 201.

[2] Dingl. Polyt. Journ., ccxxviii. 54.

tanning material to be tested, is determined by a preliminary experiment. It is advisable not to use too much solution of tanning material, as this would require the addition of such a large quantity of indigo as to make the coloring too dark to allow the final reaction to be judged with sufficient accuracy. For acidulating the titrating fluid, Kathreiner uses dilute sulphuric acid (1 : 5) of 1.18 specific gravity.

The original solution is to be filtered and the filtrate must in all cases be diluted to 2.113 pints. The duration of titration is, for the above conditions, about four minutes for the original solution, and about six minutes for the filtrate precipitated with glue.[1]

The determination of the titre is effected, as in Neubauer's method, by a $\frac{1}{10}$ normal solution of oxalic acid. Kathreiner executed the titration,[2] on account of the final reaction being

[1] Too high results are obtained by a too quick titration of the filtrate still containing glue.

[2] The process of determining the tannic acid in tanning materials, for instance in sumach, was as follows:—

Experiment a.

1. 10 c.c. of sumach, 20 c.c. of indigo } require for decolorization 13.9 c.c. of solution of potassium manganate.
2. 10 c.c. of sumach, 20 c.c. of indigo } require for decolorization 14.0 c.c. of solution of potassium manganate.

20 c.c. of sumach and 40 c. c. of indigo require therefore, } 27.9 c.c. of solution of potassium manganate.
From this is to be deducted for 40 c.c. of indigo, } 20.5 c.c. of solution of potassium manganate
Remainder, = 7.4 c.c. " " "
20 c. c. of sumach solution require therefore, 7.4 c.c. " " "

Experiment b.

100 c.c. of sumach solution are compounded in a beaker glass with
100 c.c. of glue solution and stirred, and to this are added
50 c.c. of water, containing 2.5 grms. of sulphuric acid of 1.80 specific gravity.
250 c.c. cubic centimeters.

This mixture remains standing covered over night, and is then filtered through a dry filter.

50 c.c. of this filtrate titrated with 1 litre of water and 20 c. c. of indigo, required, } 12.8 c.c. of solution of potassium manganate.
50 c.c. of the filtrate, and 20 c.c. of indigo solution, and 1 litre of water consumed, } 12.9 c.c. " " "

easier recognized, in a white porcelain saucer instead of in a beaker glass.

Kathreiner says:[1] "It would be desirable in titrating the 'filtrate' with the potassium manganate consumed for indigo, to be able also to deduct that consumed for the oxidizable substances of the glue. This may be approximately attained by comparative experiments with skin powder. But in case the oxidizable substance of the glue is not precipitated in an equal proportion to the precipitated quantity of glue, only average values are, of course, again obtained, since a like quantity of glue is not always precipitated. The case is different, if the oxidizable substance of the glue is either not precipitated at all, or entirely. Until this question is definitely settled, I propose to bring half the 'glue error' into calculation. Besides the glue error becomes less by replacing the glue solution partly by saturated solution of common salt."

In conclusion Kathreiner recommends the general introduction of Loewenthal's improved method of determining tannic acid.

Examination of Oak Bark.—1. Preparation of bark extract. A microscopical examination of oak bark shows that the tannic acid is by no means equally distributed in all parts. By placing

According to this 100 c.c. of the filtrate, and 40 c.c. of indigo solution require	25.7 c. c. of solution of potassium manganate.			
Deduction for 40 c.c. of indigo solution,	20.5 c.c.	"	"	"
Remain for the 40 c.c. of the original sumach decoction,	5.2 c.c.	"	"	"
For the oxidizable substance (not tannic acid) a 40 c.c. of sumach decoction require therefore,	14.8 c.c.	"	"	"
Deduct for oxidizable substance	5.2 c.c.	"	"	"
Remainder, =	9.6 c.c.	"	"	"

Of the total quantity of tannic acid found by titration with solution of potassium manganate 64.86 c.c. are *precipitable* with glue, and 35.14 c.c. (oxidizable substance) *not precipitable* with glue.

[1] Dingl. Polyt. Jour., ccxxviii. 62.

a few cross cuts of young and old oak bark in glycerine, and adding a very small quantity of ferric chloride, the portions containing tannic acid can be distinctly distinguished with the miscroscope by the appearance of a beautiful blue or black coloring.

The cells forming in young bark a ring between the middle and inner bark contain, according to Neubauer, no tannic acid whatever. It occurs scattered in the middle bark, in the last layer and rind. To obtain a correct average sample the ground bark should be thoroughly mixed, special attention being paid to the thorough mixing of powder and fibres, since the first, according to Neubauer, is richer in tannin than the latter.

To obtain a correct sample, T. Kathreiner[1] proposes the following method: Spread the samples taken from the different portions upon a smooth, clean support, so that the first sample occupies a surface of 15 square inches and lying 0.4–0.6 inch deep, and then add the second, third, and succeeding samples until the pile is from 4 to 6 inches high. Now take out in 8 to 10 places samples of 15 square inches, and lay them in the order as taken upon each other; but spreading them over one square foot of surface. The three or four samples of about 15 square inches each, which are to be tested, may be again laid one above the other before delivering them to the analyst. This method, of which the above is an example, must of course be changed according to circumstances as regards the extent of surface to be covered. Samples of unground valonia are sometimes taken by breaking pieces from the separate rinds with a pair of pincers. Kathreiner advises the taking also of the part of the cup upon which the acorn sits, as this consists largely of cells containing only traces of tannin.

Neubauer pulverizes a sample of 1000 grms. in a steel mill. A portion sufficiently large for analysis is completely dried in a water-bath at 212° F., and, while hot, placed in a carefully dried matrass, and this hermetically closed. When cold, the quantity required for preparing the aqueous extract is weighed off in portions of 20 grms. each. It is best to extract an equal

[1] Gerberzeitung, xxiii. No. 12.

quantity of bark by boiling for an equally long time. 20 grms. are boiled with 750 c.c. of water for three-quarters of an hour. When cold the decoction is put in a litre flask and the latter filled with water to the mark and thoroughly shaken. The fluid is then allowed to settle, or is filtered. For each experiment 10–20 c.c., according to the greater or smaller percentage of tannin in the bark, are taken out with a pipette.[1]

10–20 c.c. of this aqueous extract, 20 c.c. of indigo solution, 10 c.c. of dilute sulphuric acid, and 750 c.c. of water are placed in a large beaker glass standing upon a white support, and solution of potassium manganate is added from a Gay-Lussac or Geisler burette until the blue color passes over into a beautiful golden yellow.

The objection was raised to this method of determination that the bark extract is not a pure tannin solution, but contains, as previously mentioned, a series of other bodies, and that the tannic acid occurring in oak barks, which Wagner designated as physiological is not identical with the pathological, *i. e.*, the tannin of gall-nuts, to which the results are referred. Regarding the last objection, it must be admitted that the results obtained do not give the absolute percentage of tannic acid in the oak bark. The figures obtained are only relative, but perfectly comparable with each other. The tanner and technologist do not, as a general rule, care to know the absolute percentage of tannic acid, but only wish to find out how much more tannic acid one bark contains as compared with another, and for this purpose the method in question furnishes very useful results.

But, on the other hand, the first objection, that oak bark con-

[1] Neubauer (Zeitschr. f. analyt. Chemie, 1871, 32), shows that boiling even for three hours has no influence whatever upon the result, and that therefore Neubrand's assertion that tannic acid is decomposed by boiling in water, is incorrect. Neubauer confirms Lippowitz and Mittenzwei's opinion that a part of the tannic acid is more fixed and can only be extracted with difficulty or not at all by water alone. He found that a different result was obtained as regards the percentage of tannic acid in one and the same bark, according to whether it was extracted cold or warm.

The percentage of tannic acid soluble with difficulty varies in the different barks. Barks extracted cold still contain some tannic acid which can be extracted by repeated boiling.

tains various organic substances which, by suffering destruction by the solution of potassium manganate, influence the results, cannot be denied.

To these substances occurring in aqueous bark extracts belong among others, pectic acid, malic acid, fats, etc. Cech[1] has already made experiments in regard to the behavior of dilute solutions of acetic, malic, tartaric, and citric acids, sugar, dextrin, gum, fat, caffeine, urea, etc., towards solution of potassium manganate. He found that these substances in dilute solutions are not oxidized, and only after some time when in a concentrated state.

To avoid therefore any effect of the solution of potassium manganate upon the substances, it is only necessary, according to Cech's proposal, to thoroughly dilute the bark extract.

Neubauer, by repeated experiments, established the fact, that pectic acid exerts no influence whatever upon solution of potassium manganate. He found, in making these experiments, that pure animal charcoal possesses the property of withdrawing all the tannic acid from a fluid containing it in solution. Taking this as a basis, Neubauer proposes the following modification of Loewenthal's method.

The tannic acid contained in 10 to 20 c.c. of bark decoction is determined with solution of potassium manganate in the manner described above. Another portion of 10–20 c.c., is treated with pure animal charcoal until the filtrate, after an addition of sodium acetate and ferric chloride, shows no reaction of tannic acid. The filtrate is compounded with 20 c.c. of indigo solution and 10 c.c. of dilute sulphuric acid, and the whole diluted with water to 700–800 c.c., and then titrated with potassium manganate. The number of cubic centimeters of potassium manganate is, after subtraction of the quantity required for the indigo, deducted from the cubic centimeters of potassium manganate found in the first titration, the quantity of pure tannic acid being calculated from the remainder. In the treatment with animal charcoal pectic acid and other substances suffering decomposition by potassium manganate remain in solution. The quantity of solution of potassium manganate required for

[1] Zeitschr. f. analyt. Chemie, vii. 134.

them is determined by itself and may be brought into the calculation. Substances not withdrawn by animal charcoal required 0.20–0.25 c.c. of potassium manganate for 10 c.c. of bark extract. Too high results are obtained by Loewenthal's method from tanning materials containing, besides tannic acid, gallic acid which is also oxidized by solution of potassium manganate and withdrawn, like tannic acid, by animal charcoal. For such materials as, for instance sumach, valonia, dividivi, etc., it is best to use either Hammer's or Risle Bennat's method.

Loewenthal[1] himself has, as already mentioned, modified his method. In determining the tannic acid in barks he proceeds as follows. He titrates first with solution of potassium permanganate in the presence of indigo solution, the quantity of solution of potassium permanganate consumed in this process, indicating the amount of tannic acid and other oxidizable substances present. He precipitates then from a fresh measured portion of the bark extract all the tannic acid with glue, or as mentioned under Hammer's method, with prepared skin powder, and filters after the precipitate has settled to the bottom. A measured quantity of the filtrate is then compounded with indigo solution and titrated with solution of potassium permanganate. The data for calculating the quantity of tannic acid are obtained by deducting the amount of solution of potassium permanganate consumed in the second titration from that in the first. This method gives, according to Proctor,[2] good results and is easily executed.

Comprehensive Comparison of the Results obtained by the above described Methods.—We give here a tabular compilation by Hallwachs,[3] who compared the different methods of determination by analyzing the same bark according to various methods. The following figures show how great are the differences:—

[1] Zeitschr. f. analyt. Chemie, 1877, 33.

[2] Chem. News, 1877, No. 924, xxxvi.

[3] Dingl. Polyt. Journal, clxxx.

Percentage of Tannic Acid determined according to the Method of

Bark.	Fehling, Müller.	Loewenthal.	Hammer.	Fleck.	Mittenzwei.
A . . .	6.16	....	5.24	....	....
B . . .	6.11	....	5.25	....	....
I . . .	13.80	13.24	13.00	12.10	14.07
II . . .	9.74	9.35	9.00	8.48	10.31
III . . .	9.25	9.28	8.77	8.15	10.22
IV . . .	8.90	8.57	8.00	7.48	9.27

According to this table, the results obtained by Mittenzwei's method are 0.5 to 0.8 per cent. too high as compared with those by Fehling-Müller's and Loewenthal's methods. The results obtained by Fleck's method are the lowest, being 0.5 to 0.7 per cent. less than those by Fehling-Mueller's and Loewenthal's, which nearly agree. Between these two are the results obtained by Hammer's method, which are somewhat lower than those by Fehling-Müller's and Loewenthal's. By assuming with Neubauer that, in the presence of pectine, the results obtained by Loewenthal's method are too high, it appears that results, which nearly agree, are obtained by Hammer's and Loewenthal's modified methods.

Note.—For portions of the matter contained in this chapter the sources which have not been specifically indicated, the author desires to acknowledge his indebtedness to Bolley's Technologie, 35 (Bd. vi. 4), Heinzerling, also to Dictionnaire de Chimie, Pure et Appliquée, Wurtz, iii. 193 *et seq.*

CHAPTER IX.

WATER.

SECTION I. GENERAL REMARKS CONCERNING WATER.

WATER occupies an important position in tanning, it being employed, on the one hand, for washing, cleansing, and preparing the raw hides, and on the other, as a solvent for all the tanning materials and as a diluent for all the coloring and dyeing materials used.

Empirics have frequently unfairly overestimated the importance of water in tanning by declaring water containing more or less mineral constituents entirely unfit for the preparation of many varieties of leather.

Although it cannot be denied that a higher or lower degree of hardness of the water is a factor deserving close consideration in the manufacture of leather, it must not be overestimated to such an extent as to lay the blame for obtaining a poor quality of leather entirely upon the properties of the water.

We will here briefly discuss the most important admixtures of water, and their influence in tanning.

All naturally occurring water contains smaller or greater quantities of alkaline and earthy alkaline salts, and carbonic acid in solution. There is no entirely pure well or river water, *i. e.*, free from all admixtures. By leaving out of consideration the small quantity of ammonium nitrite, organic substances, etc., held in solution by rain water, the latter might be considered chemically pure water.

Water is distinguished as *hard* and *soft*, according to the quantity of earthy alkaline salts it contains, the amount of mineral substances varying from 1 milligrm. to 1 grm. per litre. The principal admixtures occurring in water are, as mentioned above, the alkalies, such as potassium, sodium, alka-

line earths, lime, and magnesia; the oxides of a few heavy metals in combination with ordinary mineral acids, sulphuric, nitric, phosphoric, carbonic, and hydrochloric acids. The gases held in solution are chiefly carbonic acid and atmospheric air, sulphide of hydrogen occurring but seldom.

The admixtures of spring and well water consist principally of the constituents of the layers of earth through which it percolates. Those, for instance, contained in the waters flowing through the dolomitic stratification may be considered as pure solutions of the dolomitic rock, consisting as they do of calcium carbonate, magnesium carbonate, and silicic acid, the quantity of all other constituents being so small as to make it almost impossible to determine them by quantitative analysis. The waters percolating through the basalt and the new red sandstone contain principally calcium carbonate, magnesium carbonate, silicic acid, considerable quantities of free carbonic acid and small quantities of common salt, calcium sulphate, and sodium carbonate. The total dry residue of waters coming from the lias formation varies between 268 and 516 milligrms., the principal constituents being in this case also calcium carbonate, 200 to 400 milligrms. per litre, magnesium carbonate (varying from 30 to 90 milligrms. per litre), sodium carbonate, free carbonic acid, etc.

Besides these natural constituents, spring and well water, but especially the latter when in large cities or in the neighborhood of dumping places for all kinds of offal, the soluble substances of which percolate through the soil, contain frequently in solution organic products of decomposition of organized bodies such as bacteria, fungi, alkaline nitrates, especially ammonia, and alkaline salts. Though such water, for hygienic reasons, is generally unfit for drinking purposes, it may be put to technical use.

In determining the qualities of water for tanning purposes, two points, as mentioned, must be taken into consideration, viz., first, the behavior of the water when used as a solvent for the tanning materials, and second, whether it is adapted for preparing the hides for tanning. If the water is to be used for dissolving or extracting tanning materials containing tannic

acid, the earthy alkalies, lime and magnesia combinations, exert a decidedly injurious effect, as, by forming insoluble combinations with the tannic acid, they render a part of the tanning material useless. If the water is to be used for soaking, cleansing, and washing the hides, mineral admixtures may exert a favorable influence. In speaking of the chemical properties of the skin tissue and the coriïn, we mentioned that some of the alkaline salts exert a dissolving influence upon the intercellular substance or coriïn, the effect of small quantities of alkalies being an increased solution of coriïn in acids. From this we may draw the conclusion that hard water promotes the soaking of dried hides, but that a part of the coriïn is withdrawn from the skin tissue if the hide is too long subjected to the action of the water.[1]

Hides intended for sole leather are *swelled* or "plumped" in order to cause them to be better adapted to the absorption of the tanning material. In case the natural swelling is not sufficient, it is assisted by the use of inorganic as well as organic acids. This swelling process is, for the reasons previously stated, accelerated, and the falling back of the hides into their previous state prevented by the use of hard water.

Soft water is preferred for the manufacture of upper leather, as the hides must not be swelled as much as those for sole leather, as otherwise the smooth cut would be injured.

The temperature of the water used for preparing the hides must also be taken into consideration. Generally speaking, the water should be as cold as possible for the manufacture of sole leather to prevent the skin fibre from being softened too much.

[1] Eitner (see Der Gerber, 1877, No. 178, and Dingl. Polyt. Journ., ccxxiv. 524) has made experiments as regards the effect of different inorganic constituents of water upon the depilated skin, using various solutions of alkaline, calcium, and magnesium salts in distilled water. He found that water containing only calcium chloride and magnesium chloride had almost no swelling effect, and distilled water scarcely any, it being further remarked that carbonic acid, and consequently water containing bicarbonates, exerted a swelling effect upon the hide. Alkaline chlorides and alkaline earths, such as magnesium chloride, potassium and sodium chlorides, have no swelling effect whatever, even nullifying it partly. Calcium and magnesium sulphates proved the best swelling materials for hides, this explaining the advantageous effect produced in swelling by a careful addition of sulphuric acid to water containing much bicarbonate.

It is also of importance that the water should not be exposed to too great variations in temperature in summer and winter; 46 to 50° F. may be designated as the most favorable temperature. Spring water coming from deeper strata of the soil, and possessing consequently a more even temperature, is to be preferred to river water.

In the manufacture of waxed-calf, it is important that there should be a uniform temperature of the water in which the skins are soaked, and but few of the best manufacturers of this class of leather in France or Germany soak the skin in the running water of the river, because it is extremely cold in winter and warm in summer. In default of water from a live source, it may be drawn from the cistern; but you will say, it requires a large quantity of water, and that it will be costly to draw it to the surface. But it is very seldom that a tannery does not possess a horse or a steam engine; the horse is often idle in the stable; the engine has always a little power to spare above its requirements; or by means of the simplest machinery a double action pump may be constructed and made to work by horse or steam power, and in this way there can be obtained from 2000 to 2500 gallons per hour more if desired. There should be in the centre of the tannery or in one of the corners, a large tank raised at least six feet above the ground; the water, pumped into the tank, can be distributed at will over the whole establishment. The total expense may amount to $500 or $600; and such a figure is not large in consideration of the importance of the result: to have always at disposal a quantity of pure water and of an equal temperature. It makes a much greater difference in the manufacture of waxed-calf than with any other class of leather, whether the water is hard or soft; still some prefer it soft, as it contains less calcareous substances than hard water, which is, as we have explained, often saturated with earthy salts. We do not pretend to give in this work the analyses of all the waters that trickle through our soil; it is the tanner's business to become acquainted with the quality of the water he has at his disposal, and to utilize it according to the elements it contains. Study the water; if it is soft the soaking will be done promptly, if it is hard it will take longer;

but, any way, there is a certainty of arriving at the same result; that is the aim.

As regards the chemical examination of water, we refer the reader to the following section of this chapter.

Section II. Methods for Determining the Constituents of Water.

We cannot enter upon a description of the different qualitative and quantitative methods of determining the constituents of water; but will only briefly describe a few examinations of importance in tanning, and those who may desire a full description of the methods and apparatus employed, are referred to the treatises of Wanklyn and Frankland on Water Analysis.

The qualitative examinations of water as to its admixtures of lime, magnesia, alkalies, chlorine combinations, sulphuric and carbonic acid, the larger or smaller quantity of which generally determines its character, can be executed in the following manner:—

1. The chlorine combinations are shown by the formation of a white precipitate when treated with nitrate of silver in nitrate solution.

2. Sulphuric acid and sulphates are recognized by the formation of a white precipitate with barium chloride.

3. Carbonic acid is present when the addition of clear lime-water gives a white precipitate.

4. The presence of silicic acid, lime, and magnesia, by evaporating to dryness with an addition of hydrochloric acid in a platinum dish of a capacity of about 1 litre. The residue is taken up with hydrochloric acid and water, the portion remaining undissolved being silicic acid. The lime can be separated as calcium oxalate from the filtrate with ammonium oxalate. After removing the calcium oxalate by filtration and evaporation of the filtrate, the magnesia is precipitated with ammonium phosphate as ammonium magnesium phosphate.

5. Organic substances are shown by adding a few drops of potassium permanganate and some pure sulphuric acid. If organic substances are present, the potassium permanganate,

added drop by drop, is decolorized until all the organic substances are completely oxidized.

6. Determination of the entire residue. 1 litre is carefully evaporated to dryness, requiring from twenty-four to twenty-six hours, in a platinum dish, the weight of which has been previously determined. The residue is dried at 356° F. until a decrease in weight no longer takes place.

7. A determination of hardness with alcoholic soap solution serves in most cases for tanning purposes as a substitute for a quantitative analysis. We give, therefore, a short description of it.

The process of determining the hardness of water by a soap solution of a determined percentage, which was introduced by Clark, is a very simple one. By an addition of soap solution to water containing too much lime or magnesia, a white precipitate of lime or magnesia soap insoluble in water is formed as long as calcium or magnesium salts are present. When an excess of soap solution has been added, the end of the reaction is indicated by the formation of lather on shaking the fluid.

The effective value of the soap solution is determined by testing it with a lime solution of a determined percentage. Clark's method is, according to Faisst and Knauss, executed in the following manner:—

The soap solution required for titration is obtained by dissolving 30 grms. of dried soda soap in 3 litres of alcohol of 90 per cent. The turbid solution is filtered and preserved for use. 200 grms. of this concentrated solution are first compounded with 150 grms. of water (in order to reduce the alcohol to the strength of 56° Tralles, which has been proven to be the most suitable), and then with 130 grms. of spirit of wine of 56° Tralles. 45 c.c. of the solution thus obtained are required for the precipitation of 12 milligrms. of lime in 100 c.c. of water. The exact titre of this solution must be further determined and corrected by adding concentrated soap solution, or alcohol of 56° Tralles, so that 12 milligrms. of lime require exactly 12 milligrms. of soap solution. For the determination of the concentration of the soap solution a neutral solution of calcium chloride is used, which is obtained by dissolving 0.214 grm. of

calcium carbonate in hydrochloric acid, evaporating the solution, and dissolving the residue to 1 litre. 100 c.c. of this solution contain 12 milligrms. of calcium oxide, or an equivalent quantity of calcium chloride. With this solution the soap solution is tested, and the latter sufficiently diluted, so that exactly 45 c.c are required to produce, when brought together with 100 c.c. of lime solution, and shaken, a white lather remaining for about five minutes.

The process of determining the hardness is as follows: A distinction is made between "total hardness" and "permanent hardness." The hardness of water not heated is called "total hardness," and the hardness produced by the earthy sulphates is termed "permanent hardness," because unaffected by ebullition. The term "temporary" or "changeable hardness," being also frequently used to denote the hardness produced by the earthy carbonates, because removable by ebullition.

1. *Determination of Total Hardness.*—100 c.c. of water are measured with a pipette into a glass, having a capacity of 200 c.c., and provided with a ground stopper. Water containing much lime is previously diluted with distilled water, so that to a determined number of cubic centimeters (10, 20, or 30) of the water to be tested, 90, 80, or 70 c.c. of distilled water are added. A mark on the glass indicates the point to which it is filled by 100 c.c. of the fluid.

Before adding the soap solution, the free carbonic acid is partly removed by shaking the water.

As most well-waters have more than 12° of hardness, only 10 c.c. of the water to be tested are measured off, and diluted to the mark with distilled water. Titrated soap solution is then slowly added from a burette until, after vigorous shaking, a dense delicate lather is formed which will hold for about five minutes. The soap solution is first added in half cubic centimeters and later on in drops. The shaking must always be done in the same manner, and the volume of the fluid amount to 100 c.c. before the soap solution is added. Should a second experiment be necessary, the same quantity of water is used, or, in case but little soap solution has been consumed for the diluted water (10 : 100), correspondingly more (25–50 c.c.), so that the quantity of soap solution, which should previously be

approximately calculated, does not exceed 45 c.c. With the assistance of the following table, the respective degree of hardness which, in case the water has been diluted, must be multiplied with the corresponding figure, is found from the cubic centimeters of soap solution consumed. (The corresponding figure is found by dividing 100 by the cubic centimeters used for the experiment.)

3.4 c.c. soap solution consumed . .	0.5 degree of hardness.
5.4 " " " " . .	1.0 " "
7.4 " " " " . .	1.5 " "
9.4 " " " " . .	2.0 " "

The difference of 1 c.c. of soap solution = 0.25 degree of hardness.

11.3 c.c. soap solution consumed . .	2.5 degree of hardness.
13.2 " " " " . .	3.0 " "
15.1 " " " " . .	3.5 " "
17.0 " " " " . .	4.0 " "
18.9 " " " " . .	4.5 " "
20.8 " " " " . .	5.0 " "

The difference of 1 c.c. of soap solution = 0.26 degree of hardness.

22.6 c.c. soap solution consumed . .	5.5 degree of hardness.
24.4 " " " " . .	6.0 " "
26.2 " " " " . .	6.5 " "
28.0 " " " " . .	7.0 " "
29.8 " " " " . .	7.5 " "
31.6 " " " " . .	8.0 " "

The difference of 1 c.c. of soap solution = 0.277 degree of hardness.

33.3 c.c. soap solution consumed . .	8.5 degree of hardness.
35.0 " " " " . .	9.0 " "
36.7 " " " " . .	9.5 " "
38.4 " " " " . .	10.0 " "
40.1 " " " " . .	10.5 " "
41.8 " " " " . .	11.0 " "

The difference of 1 c.c. of soap solution = 0.294 degree of hardness.

43.4 c.c. soap solution consumed . .	11.5 degree of hardness.
45.0 " " " " . .	12.0 " "

The difference of 1 c.c. of soap solution = 0.31 degree of hardness.

Suppose 50 c.c. of the water to be tested had been placed in the glass and diluted with 50 c.c. of distilled water, and had consumed 22.6 c.c. of soap solution for the formation of lather. According to our table these 22.6 c.c. of soap solution correspond to 5.5 degrees of hardness. This figure 5.5 is multiplied by 2, which gives 11 as the actual degree of hardness of the water. (The figure 2 is obtained by dividing 100 c.c. by 50 c.c.)

2. *Determination of Permanent Hardness.*—For the determination of the permanent hardness 500 c.c. of water are boiled in a sufficiently large matrass for at least one and a half hours, a part of the evaporated water being replaced by distilled water. The boiled water, when cold, is poured into a flask having a capacity of 500 c.c., and the matrass rinsed out with distilled water, the rinsing being added to the water in the flask. The latter is then filled with distilled water up to the mark, and the entire contents filtered through a dry filter into a dry glass. The degree of hardness of a definite number of cubic centimeters is then determined in the above manner.

Clark was the first to introduce the term "degrees of hardness," 1 degree corresponding, according to him, to 1 part (grain) of calcium carbonate or its equivalent of another calcium salt, or equivalent quantities of magnesia or magnesium salts in 70,000 parts (=1 gallon) of water. At the present time 1 degree of hardness is suitably estimated as equal to 1 part of calcium oxide in 100,000 parts of water. The German degrees of hardness are reduced to English by multiplying the degrees found by 5 and dividing by 4, the reduction of English to German degrees being *vice versa*, accomplished by multiplying by 4 and dividing by 5. In France 1 degree of hardness is calculated as equal to 1 part of calcium carbonate in 100,000 parts of water, 1 degree of hardness being therefore:—

In Germany = 10 milligrms. of calcium oxide in 1 litre of water.

In France = 5.6 milligrms. of calcium oxide in 1 litre of water, or an equivalent quantity of magnesia or magnesium salts.

PART III.

CHAPTER X.

BARK—THE NATURE OF BARK—TOOLS USED IN BARKING—ROSSING BARK—LIST OF AMERICAN PATENTS FOR BARK-ROSSING MACHINES—PREPARING BARK FOR TRANSPORTATION—LIST OF AMERICAN PATENTS FOR PREPARING BARK FOR TRANSPORTATION.

HAVING in the preceding chapters treated of the various barks used in tanning, we shall now, previous to taking up the subjects of grinding and leaching bark, discuss the manner and time for peeling, etc.

Bark is the outermost covering or rind of vegetables. It envelops the whole plant from the extremities of the roots to the extremities of the branches. If a branch of a tree be cut across, and we inspect such a horizontal section with attention, we perceive that the bark is composed of three distinct bodies, which, with a little care, may be separated from each other. The outermost of these bodies is called the *epidermis*, the middle one is called the *parenchyma*, and the inner one, or that next the sap wood, is called the *cortical layers*.

The *epidermis* is a thin, transparent membrane, which covers all the outside of the bark, and it is, however, generally seen only in annual stems, or in the younger parts of woody stems. When inspected with a microscope, it appears to be composed of a number of slender fibres crossing each other and forming a kind of network. It seems even to consist of different thin, retiform membranes, adhering closely together. This at least is the case with the epidermis of the birch, which Duhamel separated into six layers. The epidermis, when rubbed off, is reproduced. In old trees, it cracks and decays, and new epi-

dermides are successively formed. This is the reason that the trunks of many old trees have a rough surface.

Davy was induced by some observations of Mr. Coats, of Clifton, to examine the epidermis of the bamboo, the sugar-cane, and the *Equisetum hyemale.* He found in them a great quantity of silica. When examined under the microscope, the epidermis of these gramineous plants constitutes a brilliant retiform tissue, which gives it the harsh feel by which it is distinguished. The epidermis of the bamboo was found to contain 17.4 per cent. of silica, and it has the appearance, when pulverized, of pounded glass. He also found silica in the epidermis of the sugar-cane, the common bog reed (*Arundo phragmites*), wheat, barley, and oats. He found a still greater proportion of silica in some other of the gramineous plants.

The *parenchyma* lies immediately below the epidermis, it is of a deep green color, very tender and succulent, the outer layer of which is called *epiphlœum*, and the inner layer *mesophlœum.* Within the mesophlœum is a distinct layer called *liber* or *endophlœum.* When viewed with a microscope, the *parenchyma* seems to be composed of fibres which cross each other in every direction. Both in it and the epidermis there are numberless interstices, which have been compared to so many small bladders.

The *cortical layers* form the innermost part of the bark, or that which is contiguous to the *alburnum* or sap-wood. They consist of several thin membranes, lying one above the other; and their number appears to increase with the age of the plant. Each of these layers is composed of longitudinal fibres which separate and approach each other alternately, so as to form a kind of network. The meshes of this network correspond in each of the layers, and they become smaller in every layer as it approaches the wood. These meshes are filled with a green-colored cellular substance, which has been compared by anatomists to a number of bladders adhering together, and communicating with each other. The bark increases by the addition of an annual layer on its inner surface, next to the *alburnum* or *cambium*, through which the sap circulates.

Fourcroy supposes that the epidermis is the same in its

nature in all trees, and that it possesses constantly the properties of cork; but this opinion is not verified. The cortical layers seem, at least in many cases, to have a similar fibrous basis; a basis possessing essentially the properties of flax, which is itself merely the cortical layers of *linum usitatissimum*. Common cork, which constitutes the epidermis of the *Quercus suber*, is composed of a cellular tissue, whose cavities contain a variety of foreign substances, which may be separated by rasping down the cork and treating it by various reagents, as is done with wood, in order to free the *lignin* from foreign matters. Ten parts of common cork, when treated in this way, are reduced to seven. This residue is considered by Chevreul as a peculiar substance, which he distinguishes by the name of *suberin*.

We have already stated that bark is composed of four parts; all are not equally rich in tannin, or rather some contain none. Such is the case with the epidermis, the liber contains very little. It is in the inner layer of the cortex that it is principally found.

Peeling the Bark and the Most Convenient Time for it.

Experiment has demonstrated that it is in the spring, when the sap is in full activity, that the bark should be peeled. We have said that all the regenerating and vivifying power resided in the bark. The suckers, the slips, the buds present us a proof of this first fact. The willow, olive, mulberry, and a multitude of other trees, the trunks of which are entirely rotted and the bark alone forms the support, are often covered with leaves and flowers. This is due to the great quantity of nutritious juices conveyed by the bark. These abundant juices are sometimes different from those of the wood. Often, also, while of the same nature, they are in so great a proportion that they break the bark in order to exude, or it is sufficient to make incisions to have them run out. Almond trees, acacias, apricot trees, etc., are examples. It results from these facts, that while the sap is abundant in the bark in the spring, principally towards May, that that is the proper time for barking. Independently of numerous experiments of tanners, which demonstrate the superiority for tanning of the bark cut

in the spring, chemical analysis throws light on this important fact. Indeed, Davy has demonstrated that

Oak bark cut in the spring contains of tannin	. .	6.04
" " " fall " " "	. . .	4.38

Which gives nearly one-third more in the spring. Here theory agrees with practice, both recommending the spring as the time when the bark is richer in sap and tannin. The barking is done by cutting circularly the bark from the trunk at both ends, and splitting it longitudinally. The bark is dried slowly in the shade, and care is taken to protect it from mould.

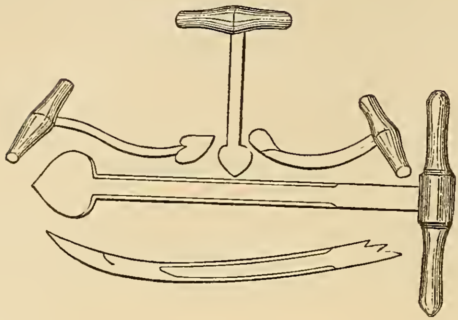
Influence of Seasons and Place at the Time of Barking on the Richness in Tannin.

We have said above that the spring is the best time to bark, but this time may be more or less advanced according to the temperature. Thus, if the winter has been severe and the spring cold, it will be only in the middle or the end of May that vegetation will begin, and the barks will not be so rich in tannin. On the contrary, if the winter has been mild and the spring warm, April is the most convenient time. In temperate climates it is by the end of April, or the beginning of May, that this operation commences. The barks are much richer in tannin as they come from trees of warm countries, *i. e.*, the tannin is developed in greater proportions the further south it is. In the same locality oaks well exposed to the south and in dry and elevated places give barks richer in tannin. On the contrary, if they are in the shade in a low and damp locality they contain less. It is the same for rainy seasons, which have great influence in the production of tannin. The barks are aqueous and sur-saturated with vegetable matter. These facts, while apparently trifling, are of decided interest to tanners.

Tools used in Barking.

In addition to the axe or hatchet for slitting the bark and making the cuttings around the trunk, thereby enabling it to be removed in lengths, the workmen employed in this operation require other tools which they call "spuds" or "peeling

Fig. 10.



irons," which are worked underneath the bark in order to loosen it. A set of these tools is shown in Fig. 10.

A Contrivance for cutting Bark preparatory to Peeling.

The invention shown in Figs. 11 to 15, which is the idea of Mr. J. Daigneau of St. Hyacinthe, in the Province of Quebec, Canada, relates to a new and improved machine for cutting bark into suitable lengths around a log or trunk of a tree. In peeling bark for tanning or other purposes such cuttings have commonly been done hitherto by the axe after felling the tree; but by this machine the work of cutting around the tree can be done much more expeditiously and with better results.

In obtaining bark the usual practice is, first, to fell the tree, and then measure off four feet, or the desired length, and then cut the bark around the trunk with an axe, and thus to measure and cut the bark the whole length of the tree trunk. This machine consists of a long lever or bar, made of wood or any suitable material, having near one end a mortise or slot cut through the lever, and through this mortise is inserted the shank of a knife-holder, and the shank is adjustable in the mortise and held there by a bolt or pin which passes through the bar and shank; the machine is somewhat in appearance and mode of use like what is commonly known as a "cant-hook" for rolling logs.

Figure 11 is a side elevation with a section of a tree-trunk to which the machine is applied. Fig. 12 is a view of the under

side of the bar, the knife being removed. Fig. 13 is a side and bottom view of the knife and knife-holder and spring detached

Fig. 11.

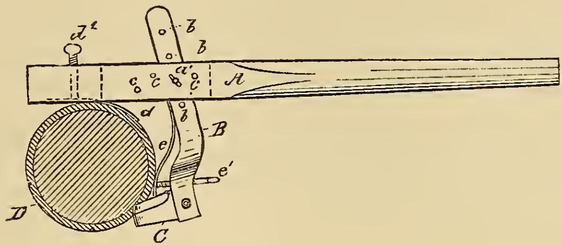


Fig. 12.

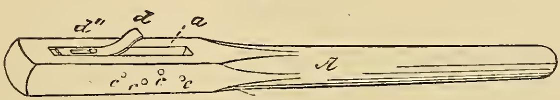


Fig. 13.

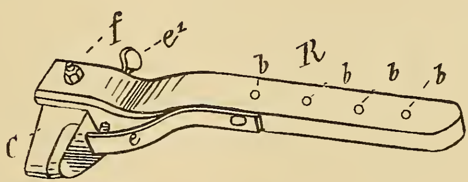


Fig. 14.

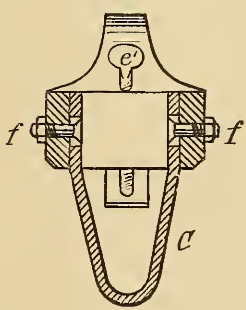
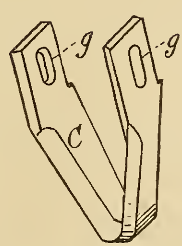


Fig. I5.



from the lever or bar. Fig. 14 is a cross-section of the knife-holder and knife, showing how the knife is held to the holder. Fig. 15 is a partial side view of the U-shaped knife detached

from the knife-holder, showing the form of the knife, and the slots *g*, through which pass the bolts *f*, as seen in Fig. 14.

The letter A represents the bar or lever; B, the knife-holder; C, the U-shaped knife; D, a section of a trunk of a tree; *a*, the mortise in the lever, and *a′* a bolt passing through the lever and knife-holder; *b*, holes in the shank of the knife-holder; *c*, holes through the lever; *d*, a spring attached by a screw, *d′*, to said lever, having a slot, *d″*, at its point of fastening; *e*, a spring on said knife-holder, and *e′* an adjustable screw operating said spring *e*; *f*, screws holding the knife to the knife-holder, and *g g*, slots in the ends of the knife.

The lever A in practice is five or six feet long, and is made of wood. It has holes *c* (see Figs. 11 and 12), through which passes the pin or bolt *a′*, and these holes pass through the mortise or slot *a*. These holes are for the purpose of adjusting the knife-holder to the size of the tree-trunk, as also are the holes *b* in the shank of the knife-holder. The knife-holder (see Figs. 11 and 13) is from one to three or more feet in length, and is made of metal, and pronged at one end for the purpose of holding the U-shaped knife. This holder has a spring, *e*, on its under side, against which presses an adjustable screw, *e′*, which passes through the holder. (See Figs. 11, 12, 13, 14.) It will be observed that the spring, which is fastened to the lever by a screw, *e′*, presses upon the spring and adjusts it to the tree-trunk, and is a guide for the thickness of the bark.

Fig. 14 shows the method of adjusting the knife to the holder. The screws *f* pass through the slots *g* from the inside, and are made fast by nuts on the outside. The slots *g* serve to adjust the knife to the thickness of the bark by raising or lowering the knife. Fig. 11 shows how the machine is applied to the tree-trunk, whether the tree is standing or cut and fallen.

To save the bark before felling the tree it is usual first to cut around the trunk of the tree near the ground, and then above, the length or one cutting, and strip off the bark. The tree is then felled and trimmed. The workmen then pass along, one on each side of the trunk, for convenience and expedition of the work, and one workman takes the machine by the handle and applies it in the manner shown in Fig. 11, and cuts from the

under side to the upper side of the trunk and passes the machine to the workman on the other side of the trunk, who cuts the remaining part in the same manner.

The advantage of this form of knife is readily seen. The cutting is a grooved one, and leaves the edges of the bark smooth and of even length, with but little waste.

In small trees having thin bark a single or straight knife-blade might accomplish the cutting; but in thick bark the knife would be liable to break.

It will be observed that the spring *d*, attached to the lever A, and the spring *e* to the holder B, partly clap and press against the tree-trunk.

They guide and aid the knife and steady the machine.

Rossing Bark.

The outer coating of bark after continuous exposure to the action of the elements loses all its tanning properties, and the process of stripping this outer from the inner layer of bark is technically termed "rossing," and it is essential that the work when it is attempted should be perfectly done, for if any material quantity of the outer layer of bark be left on the inner one the process of tanning leather is unnecessarily prolonged, as the dead coating of bark has to be tanned along with the leather, and then again the leather when thus tanned has an undesirable dark color.

The bark from which tannin is obtained is, as we have seen, composed of the cortex or layer which contains the tannic acid, the cellular integument next thereto which contains the coloring matter, and the epidermis or outer bark. What thickness of the cellular integument should be removed from the whole bark has long been an open question and one upon which there has been and still is a wide difference of opinion.

It seems to be questioned whether rossing will repay the tanner after the bark is delivered on his premises; the cost of doing this work being from 40 cents to 50 cents per ton, and the material removed from the bark weighing on the average about 450 lbs.

There is no question but that it would often pay tanners to

have this work done before the bark is shipped. To pay the freightage, and handle, grind, and leach 20 or 25 per cent. of worthless material, when it could be removed in the first instance at but a small cost by a suitably contrived bark-rossing machine, is not economy.

The loss in the leach and tan-vats is twofold, for not only does this worthless material occupy valuable space, but it absorbs tannin that could more profitably be employed for tanning leather.

List of all Patents for Bark Rossing Machines issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
37,530	June 9, 1863,	B. F. Taber,	Buffalo, N. Y.
38,861	July 27, 1863,	R. Healy,	Swanton Falls, Vt.
39,888	Sept. 15, 1863,	J. Cowie,	Portland, Me.
110,403	Dec. 20, 1870,	G. S. Tallingast and J. W. Burdwin,	Morrisville, N. Y.
128,612	July 2, 1872,	C. Gilpin and J. T. Hill,	Cumberland, Md.
141,448	Aug. 5, 1873,	J. Martin and G. W. Wilson,	Morenci, Mich.
153,492	July 28, 1874,	J. Moulton,	Ossipee, N. H.
176,709 Reissue 7,264	April 25, 1876,	S. R. Thompson,	Portsmouth, N. H.

Preparing Tan-bark for Transportation.

Various methods have been devised for preparing tan-bark for transportation. Heretofore the exportation has been attended with great cost, owing to its bulky nature and the liability of the acids in the bark causing it to ferment and spoil when piled in bulk, especially in a broken or pulverized condition.

Sometimes the bark has been ground and pressed and then coated with tan-liquor on the exterior of the blocks in order to preserve it.

Mr. Wm. H. Smith, of Chicago, Ill., takes the tan-bark after it has been ground in the usual way, and places it in a strong mould, and subjects it to compression by percussion, using for the purpose, preferably, a powerful steam-hammer. Under the

influence of the hammer the tan-bark will readily compress to a density of from sixty to eighty pounds per cubic foot, forming a solid self-cohering block of great strength and tenacity, and when removed from the mould, suitable for exportation or shipment without being inclosed in any covering. These blocks may be made cylindrical, rectangular, or of any form desired, and of any suitable size. It is preferable to make them, however, of about one hundred pounds weight. The tan-bark thus prepared in blocks it is claimed will not ferment or spoil, as the air has an opportunity to circulate around each separate block, and there is consequently no tendency to heat or ferment, as is the case where ordinary pulverized tan-bark is piled in bulk. The tan-bark should be in a dry state when placed in the mould, and if it contains much moisture it should be expelled by desiccation before the material is compressed. The blocks, when placed in warm water, will soon disintegrate and the particles resume their original size and shape, so that the blocks of bark may in this way be very easily put in condition for use.

The term "self-cohering," used in describing these blocks, indicates that the particles composing the blocks cohere together naturally without the agency of any adhesive admixture.

List of all Patents for Methods and Machines for Packing Tan-bark for Transportation, issued by the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	June 6, 1812,	J. Richardson and B. Stout,	Bucks County, Pa.
	June 5, 1815,	J. Logan,	Philadelphia, Pa.
182,965 Reissue 10,211 10,230	Oct. 3, 1876,	J. Sherman, Jr.,	Chicago, Ill.
184,638	Nov. 21, 1876,	R. Loechner,	New York, N. Y.
195,377	Sept. 18, 1877,	C. Kimpler,	Chicago, Ill.
247,125	Sept. 13, 1881,	W. H. Smith,	Chicago, Ill.

CHAPTER XI.

GRINDING, CUTTING, CRUSHING, AND CONVEYING TAN-BARK—LIST OF AMERICAN PATENTS FOR BARK-MILLS.

SECTION I. GRINDING, CUTTING, AND CRUSHING TAN-BARK.

THERE are but few requirements of the tanner's business that demand a greater amount of attention, or in which there is so much room for economy, as in the grinding and leaching of bark.

One of the prime requirements of a good bark-mill is that it should yield the ground bark in a uniform condition, not partially in a coarse and partially in a powdered state; as the dust is an obstruction to the penetration of the tannin by thickening the tan-liquor, and injures the leather in appearance and quality.

The more unevenly bark is ground, the more unevenly it is leached; the most accessible particle has to stay in the leach until the most difficult has been disintegrated. If the ground bark could be very fine and perfectly uniform—which is quite impracticable—the concentration of strength of liquors would be much greater than we now get; it is well to approach as near to that result as a little care will enable one to do.

If the larger pieces are small enough, and the whole is well mixed, the bark is in condition for thorough leaching, for the leaching fluid will readily enter the whole mass. Bark dust is by no means impenetrable, but does not admit of as rapid passage of the fluid as the larger particles, and will shed it to a very large extent if the dust is allowed to accumulate in one place and be absent in another; the mixing of bark prevents this. When bark dust is penetrated, all its tannin is at once absorbed by the leaching fluid; this is not much, however, as the dust comes chiefly from the dead, useless parts of the bark.

We have now quite a number of mills which reduce or break up the bark, and which are satisfactory to tanners.

These mills are of various constructions: some grind the bark while others saw or cut it; in some the hoppers are straight, in others they are wider at the top, while in others they are made wider in the middle than at their upper or lower ends.

The stationary grinder was formerly generally made in one piece with the body of the hopper, and if any portion of the lower part was broken the entire hopper was useless and had to be replaced; but now the most exposed parts of the hopper and other portions of the mill are made in sections, and if one portion should be broken by excessive strain it can be readily replaced, while all the other parts may be retained.

Some mills have an outwardly-convex rotating sieve to separate the coarse from the fine bark, and transfer the former over the annular edges and a secondary grinding apparatus, in the form of a cylinder arranged under the ordinary mill and fastened to its shell. Those parts that are fine enough drop upon the rotating sieve and pass through the meshes. The coarse parts, however, are crushed between two sharp-toothed rings, of which the former is stationary, while the latter is fastened to the sieve and revolves with it.

An improvement made on the Troy or Starbuck bark-mill in 1869 consists in so arranging the grinders or graters in both the revolving and stationary parts of the mill one above the other, that the bark, coarsely ground by the upper, is discharged directly into the lower grinding surfaces, where it is re-ground to the required fineness, and more evenly than was done prior to that date, when the bark required rehandling before being finished.

Of late years the attention of inventors has been turned more to improvements in cutting mills than towards grinding mills for tan-bark. The horizonital, cylinder breaker bark-mill manufactured by C. Weston & Sons., Salem, Mass., is largely employed in the upper-leather tanneries of New England; it has a capacity of about two cords of bark per hour, and the price is $175. The present forms of grinding-mills used in sole-leather tanneries are mostly those upon which the

patents have long since expired; but which have been slightly changed in regard to the fitting up, as, for instance, the mill shown (Figs. 16 to 19) has a safety coupling which was not employed prior to 1875.

The object of this safety device is to prevent breakage should a foreign substance get into it, and it is the invention of Mosser.

Fig. 16.

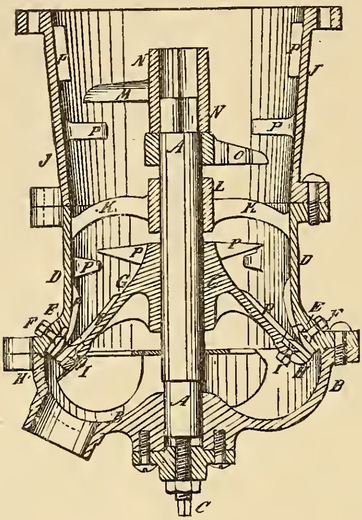


Fig. 17.

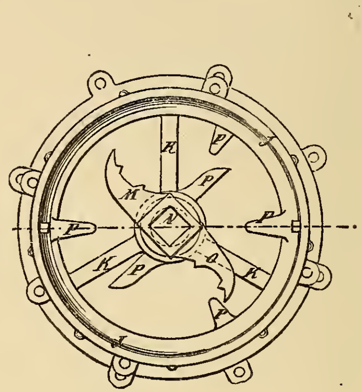


Fig. 18.

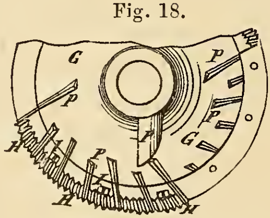


Fig. 19.

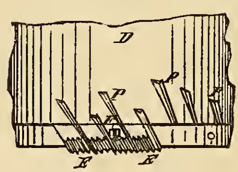


Fig. 16 is a vertical section of the bark-mill. Fig. 17 is a top view. Fig. 18 is a detail top view of the runner. Fig. 19 is a detail view of the inner surface of the lower part of a portion of the shell of the mill.

A is the shaft, the lower end of which revolves in an oil-tight step in the bottom of the bowl *B*, where it is supported adjusta-

bly by a screw-pivot, *C*, so that the mill may be readily changed to grind finer or coarser, as may be desired.

Upon the upper edge of the bowl *B* are formed lugs to correspond with lugs upon the lower edge of the shell *D*, and which are perforated to receive the bolts by which the shell and bowl are secured to each other. The lower part of the shell *D* is flared outward, or made somewhat bell-shaped, and in its inner surface is formed a ring-groove, into which are fitted toothed segments *E* of a ring-plate, which are secured in place by bolts *F*, passing through them and through the shell *D*. This construction brings the segments *E* to an inclination of about forty-five degrees. *G* is the runner, which is secured to the shaft *A*, and is made in the shape of a concaved cone.

In the lower edge of the runner *G* is formed a ring-groove to receive toothed segments *H*, which are secured in place by bolts *I*, passing through the wall of the runner *G*.

By this construction, should the toothed segments *E H* break or get dull, they can be readily detached and replaced by others.

Around the upper edge of the shell *D* are formed lugs to correspond with lugs formed around the lower edge of the upper shell or hopper *J*, and which are perforated to receive the bolts by which they are secured together. Upon the inner surface of the upper part of the shell *D* are formed the outer ends of arms *C*, the inner ends of which are formed upon a collar *L*, through which the shaft *A* passes. Upon the upper end of the shaft *A* is placed a breaker *M*, which is formed upon a long collar *N*, through which is formed a square hole, so that its lower end may fit upon the square upper end of the shaft *A*, leaving its upper end empty to receive the square lower end of the driving-shaft.

By this construction, the breaker *M N* serves as a coupling, and should be of such a strength as to drive the runner *G* under ordinary circumstances; but should any hard substance get into the mill, the collar *N* will break, and thus prevent the mill from being broken.

If desired, a breaker, *O*, may be used without being provided with a coupling collar.

Upon the shell *D*, the shell or hopper *J*, and the runner *G* are formed teeth, projections, or flanges *P*, to break the bark into pieces before it passes to the toothed or grinding segments *E H*.

The bark-mill shown in Figs. 20 and 21 is Barber's invention, and the novelty of it consists in providing the grinding or toothed segments with dovetail tenons, fitting into corresponding slots of the casing and wheel.

Fig. 20.

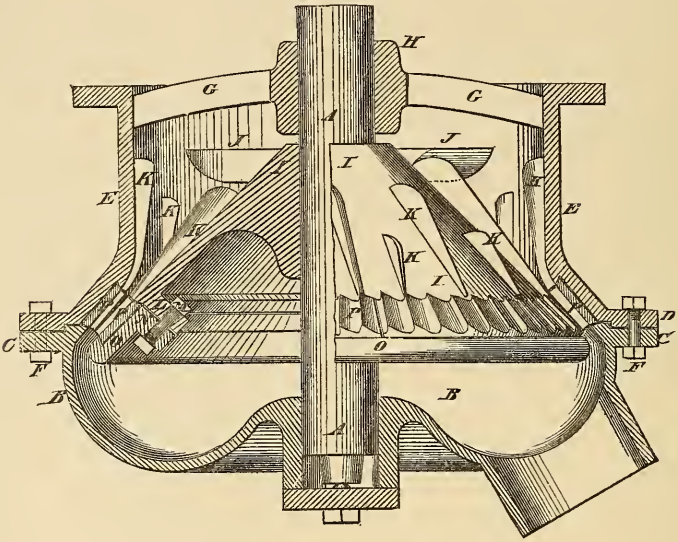


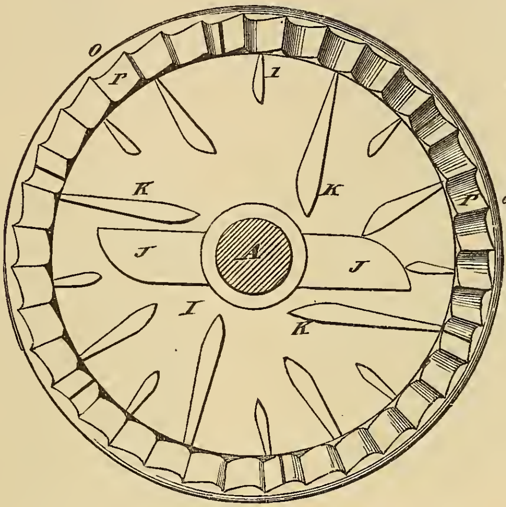
Figure 20 is a detail vertical section of Barber's bark-mill. Fig. 21 is a detail top view of the running part of the mill.

A is the driving-shaft, which revolves upon an adjustable pivot in a socket formed in the discharge-bowl *B*. Around the upper edge of the discharge-bowl *B* are formed lugs or a flange, *C*, upon which fit the lugs or flange *D*, formed around the lower edge of the upper part or case *E* of the mill, so that the parts *B E* may be secured to each other by bolts *F*, passing through the lugs or flanges *C D*.

The edges of the bowl *B* and case *E* should be rabbeted or halved to each other, so as to form a close joint even when the parts are not drawn closely together.

The upper end of the case *E* is supported by the arms *G*, the inner ends of which are connected with a collar, *H*, through which the shaft *A* passes.

Fig. 21.



To the shaft *A*, just below the collar *H*, is keyed the wheel or movable part *I* of the mill, which is made conical in its general form. To the upper part of the wheel *I* are attached radial cutters *J*, to break or cut the bark into pieces as it is thrown into the mill.

Upon the surfaces of the wheel *I* and case *E* are formed graduated flanges, cutters, or teeth *K*, to still further break up the bark as it passes down to the toothed grinding-segments.

Upon the inner side of the lower edge of the wheel *I* are formed lugs or a flange *L*, to receive the bolts *M*, which also pass through the lugs or flange *N*, formed upon the inner side of the upper edge of the ring *O*, to fasten the said ring *O* against the lower edge of the wheel *I*.

The inner surface of the lower edge of the case *E* and the outer surface of the upper part of the ring *O* have rabbets with inclined or dovetailed shoulders formed in them, which rabbets, in connection with the edges of the discharge-bowl *B* and

ring *O*, form dovetailed grooves to receive and clamp the toothed grinding-segments *P*. This construction enables the segments *P* to be made without any bolt-holes through them, and with their ends fitted against each other, so that there will be no cavities and interstices into which wet bark may stick and form a nucleus of a collection that will finally clog the mill. This construction also enables the grinding-segments to be readily taken out when worn or broken and replaced with others.

The invention shown in Figs. 22 to 30 relates to machines having rotary cutters for cutting or reducing bark for tanners' use; and it has for its object, first, to provide certain improvements in the rotary cutter, whereby the machine is enabled to run at a lower rate of speed and with less wear and jar than heretofore; secondly, to provide improved means for separating coarse fragments of bark from the properly-reduced particles; thirdly, to enable the cutter to be readily exposed or uncovered when desired.

Fig. 22.

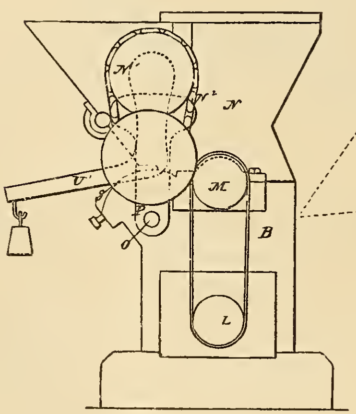


Fig. 23.

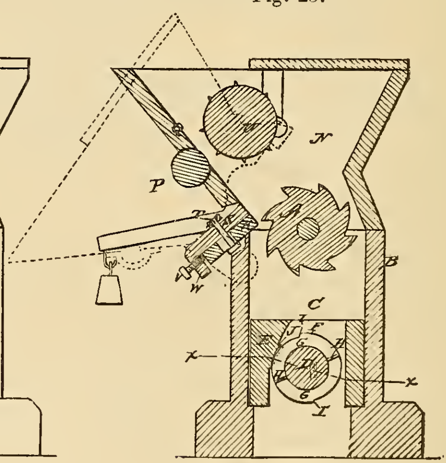


Figure 22 represents a side elevation of a bark-cutting machine embodying the invention. Fig. 23 represents a transverse vertical section of the same. Fig. 24 represents a modification. Fig. 25 represents a section on line *x x*, Fig. 23. Fig.

Fig. 24.

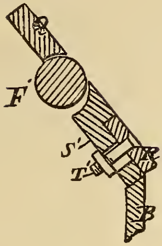


Fig. 25.

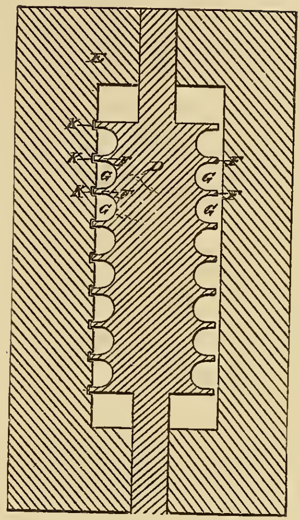


Fig. 26.

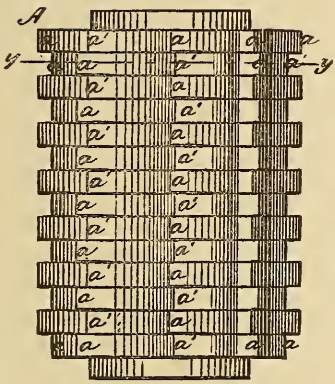


Fig. 27.

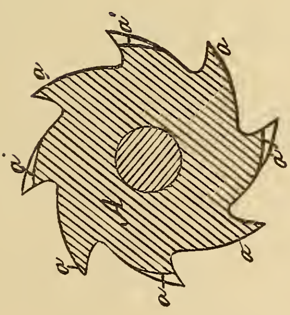
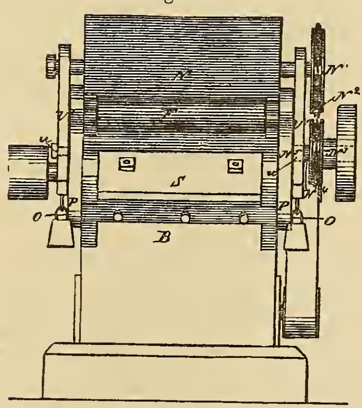


Fig. 28.



26 represents a plan view of the rotary cutter. Fig. 27 represents a section on line y y, Fig. 26. Fig. 28 represents a front view of the machine. Fig. 29 represents a side view with the

hopper turned back to expose the cutter. Fig. 30 represents a side view of the hopper detached.

In the drawings, *A* represents the rotary cutter, constituting a part of the invention. This cutter is composed of a cylindrical body and independent teeth *a a′*, projecting therefrom, the cutter being preferably formed by placing a series of saws side

Fig. 29.

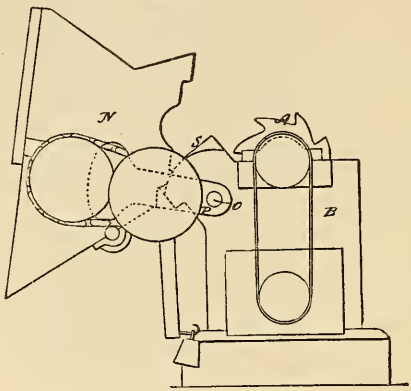
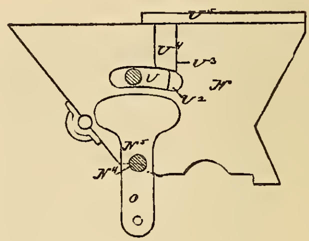


Fig. 30.



by side on an arbor, although any other suitable construction may be adopted. The teeth *a a′* are shaped like the teeth of an ordinary circular saw, and the teeth *a* are longer—that is, their points project farther from the axis of the cutter than the points of the teeth *a′*, the difference in length being preferably about one-eighth of an inch. The teeth are arranged in rows extending longitudinally of the body of the cutter, each longitudinal row being composed of alternating longer and shorter teeth, as shown in Fig. 26. The teeth forming the longitudinal rows are placed side by side, each in contact with the next, so that there are no vacant spaces between them; hence the longitudinal rows are continuous. The teeth are also arranged in rows extending around the periphery of the cutter, the teeth of each saw constituting a peripheral row. It is preferable to make these peripheral rows of alternating longer and shorter teeth, as shown in Figs. 26 and 27. By this arrangement of teeth each tooth is enabled to separate an independent fragment from a sheet or piece of bark, and no part of the end of the bark

is left untouched by each longitudinal row, as would be the case if the teeth were separated by intervening spaces, as has been usual heretofore. When the teeth are so separated the cutter has to be driven very rapidly, in order that the portions of the bark untouched by one row of teeth may be properly cut by the succeeding rows, and unless the cutter is driven very rapidly its tendency is to break or crush off the tongues left on the end of the bark by the vacant spaces between the preceding teeth, the result being the detachment of fragments too large to be properly leached and the reduction of a portion of the bark to powder, which is always objectionable in the reduced bark, because it accumulates in masses and resists the action of water in leaching.

This cutter does not require to be driven so rapidly as those heretofore used, so that less power is required to drive it and less jar and vibration are caused by the operation of the machine.

The arbor of the cutter is supported in suitable bearings on the top of a supporting-frame, *B*, which incloses a chute, *C*, below the cutter. In this chute is located a shaft, *D*, journaled in a movable frame, *E*, which is adapted to slide into and out of the frame *B*.

The shaft *D* is provided with a series of peripheral collars, *F*, and intervening peripheral grooves or pockets, *G*, about half an inch wide, and having partitions *H H*. The interior of the frame *E* forms a part of the chute *C*, and is about equal in width to the diameter of the collars, so that when pieces of bark too large to enter the pockets *G* fall from the cutter they will be arrested by the collars, the properly-reduced cuttings falling into the pockets *G*, and being carried over by the partitions *H*, as the shaft revolves.

The pieces arrested by the collars *F* may be cut or broken up by the joint action of teeth *I*, formed on these collars, and a shoulder, *J*, formed on one of the side blocks of the frame *E*, this shoulder having grooves *K*, through which the collars pass. The pieces of bark are arrested by the shoulder *J*, while the teeth *I* cut or break them. If desired, however, the shoulder *J*, and teeth *I*, may be dispensed with and the shaft *D* may be

located nearer the cutter, so that pieces of bark arrested by the collars F will be caught up by the cutter, as they accumulate, and carried over by it to the bed-plate, hereafter described, to be reduced.

N represents what we will term the "hopper-frame," which is located at the top of the frame B, and is provided with lugs P, extending downwardly and pivoted at O O to the frame B. This frame incloses and covers the cutter when in operative position, and has the general form of a hopper. One side of the frame is inclined and properly arranged with reference to the cutter to constitute a bed-plate, Q, to support the bark as it is presented to the cutter. This bed plate does not extend in one piece to the cutter, but is supplemented by a movable steel plate, R. Two methods of supporting and moving the plate R are shown, respectively, in Figs. 23 and 24. In the former the plate R is attached to an inclined plate, S, which forms a part of the frame B. The plate R, in this case, is at right angles with the bed-plate, and is attached to the plate S, by a bolt, T, passing through a slot in the plate R. Screws V, passing through a flange, W, on the plate S, serve to move the plate R at right angles to the plane of the bed-plate when the bolt T is lowered.

In Fig. 24 the plate R is attached by a bolt, T', to an inclined plate, S', forming a part of the frame B. The bolt T' is attached to the plate R, and passes through a slot in the plate S'. In this case the plate R is movable in the same plane as the bed-plate. In either case the plate R constitutes an adjustable terminus of the bed-plate, which receives the wear caused by the action of the cutter on the bark, and is capable of being adjusted to compensate for wear.

The hopper-frame N is provided with a feed-roll, U, which is positively rotated by a sprocket-wheel, N', connected by a chain, N^2, to a wheel, N^3, which is journaled on a shaft, N^4, projecting from a plate, N^5, attached to the side of the hopper-frame. The feed-roll U is journaled in weighted arms U' U', which are pivoted at u u, to the sides of the hopper-frame, and are adapted to oscillate and permit the feed-roll to move laterally.

By pivoting the hopper-frame to the supporting-frame B, as

described, and supporting the feed-roll and its driving mechanism on the hopper-frame, it is possible to readily expose the cutter by swinging back the hopper-frame, as shown in Fig. 29, whenever the cutter is to be removed or repaired, thus avoiding the labor and delay usually incident to removing the hopper and other mechanism to enable access to be had to the cutter.

The shaft of the feed-roll projects through slots U^2, in the sides of the hopper. The sides of the hopper have vertical openings U^3, extending from the slots U^2, to permit the upward movement of the shaft of the feed-roll when it is desired to remove the latter. The openings U^3, are closed when the feed-roll is in place by pieces U^4, attached to the cover U^5, of the hopper, said cover being detachable with the pieces U^4.

F' represents a friction-roll located in an opening in the bed-plate.

This invention is No. 229,205, mentioned on p. 197.

List of all Patents for Bark Mills issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	July 19, 1794,	J. Markley,	
	Mar. 17, 1802,	J. Warrel,	
	May 21, 1805,	T. W. Prior,	Philadelphia, Pa.
	May 7, 1807,	C. Tobey,	Hudson, N. Y.
	Mar. 18, 1808,	O. Pease and A. Donalds,	Norwalk, Conn.
	Mar. 20, 1811,	L. Gale,	Berkshire, Co., Mass.
	July 16, 1813,	C. Churchman and G. Martin, Jr.	Upper Chichester, Pa.
	April 18, 1814,	J. Olds,	Meriden, Conn.
	May 16, 1815,	L. Gale,	Lenox, Mass.
	Oct. 31, 1820,	N. Sears,	Hudson, N. Y.
	Nov. 22, 1821,	E. and J. Trask,	Sangerfield, N. Y.
	May 24, 1822,	J. Elliott,	Philadelphia, Pa.
	April 11, 1825,	H. Haight, Jr., and H. White,	Stamford, Conn.
	Oct. 25, 1826,	C. Foss,	Madison, O.
	Sept. 13, 1827,	W. Tarry,	Westbrook, Me.
	Mar. 27, 1828,	A. Bull,	Caroline, N. Y.
	May 29, 1828,	J. Montgomery,	Sangerfield, N. Y.
	Feb. 1, 1830,	M. Hurd,	Augusta, N. Y.
	May 3, 1831,	M. Hurd,	Augusta, N. Y.

No.	Date.	Inventor.	Residence.
	Sept. 30, 1831,	C. H. Green and R. Montgomery,	Sangerfield, N. Y.
	Feb. 27, 1832,	J. T. Gifford,	Veteran, N. Y.
	Mar. 27, 1832,	D. Humberd and G. Downs,	McConnelsville, Pa.
	April 17, 1833,	J. Trask, A. Seabury, and W. Young,	Sangerfield, N. Y.
484	Nov. 25, 1837,	C. Parker,	Meriden, Conn.
532	Dec. 26, 1837,	A. McMillen,	Bedford, N. H.
1,714	Aug. 12, 1840,	R. Montgomery and L. W. Harris,	Sangerfield, N. Y.
2,716	July 11, 1842,	V. Birely,	Frederick, Md.
2,944	Feb. 4, 1843,	B. R. Beardsley,	Sangerfield, N. Y.
3,767	Sept. 27, 1844,	M. Beecher,	Remson, N. Y.
4,090	June 25, 1845,	A. P. Norton and M. Owen,	Sangerfield, N. Y.
4,237	Oct. 25, 1845,	J. Scudder,	Plattsville, N. Y.
4,335	Dec. 26, 1845,	A. Lindsey,	Canton, Me.
6,916 Reissue 180	Dec. 4, 1849. Oct. 15, 1850.	S. A. Bant and W. Andrew,	Frederick, Md.
12,487	Mar. 6, 1855.	S. W. Powell	Tuscarora Valley, Pa.
20,692	June 29, 1858.	B. R. Beardsley,	Waterville, N. Y.
28,518	May 29, 1860,	W. Tansley,	Salisbury Centre, N. Y.
28,554	June 5, 1860.	J. Brakely,	New York, N. Y.
42,811	May 17, 1864,	M. Winger,	Ephratah, Pa.
44,756	Oct. 18, 1864,	W. Tansley,	Salisbury Centre, N. Y.
49,319	Aug. 8, 1865,	N. S. Thomas,	Painted Post, N. Y.
85,172	Dec. 22, 1868,	B. Irving,	New York, N. Y.
86,675	Feb. 9, 1869,	B. Irving,	New York, N. Y.
97,989	Dec. 14, 1869,	W. Tansley,	Salisbury Centre, N. Y.
101,984	April 19, 1870,	J. G. Curtis,	Emporium, Pa.
103,246	May 17, 1870,	R. H. Shultis,	Ellenville, N. Y.
103,881	June 7, 1870,	L. H. Hermance,	Kingston, N. Y.
107,923	Oct. 4, 1870,	C. Korn,	Wortsborough, N. Y.
111,239	Jan. 24, 1871,	G. E. Palen and F. P. Avery,	Tunkhannock, Pa.
111,397	Jan. 31, 1871,	F. Stamm,	East Lampeter, Pa.
111,744	Feb. 14, 1871,	J. Helenbrook,	Olean, N. Y.
120,246 Reissue 7,143	Oct. 24, 1871. May 30, 1876.	O. Coogan,	Pittsfield, Mass.
153,492	July 28, 1874,	J. Moulton,	Ossipee, N. H.
176,709	April 25, 1876,	S. R. Thompson,	Portsmouth, N. H.
179,401	July 4, 1876,	O. Coogan,	Pittsfield, Mass.
190,182	May 1, 1877,	W. H. Barber,	Allentown, Pa.

No.	Date.	Inventor.	Residence.
190,777	May 15, 1877,	W. F. Mosser,	Allentown, Pa.
198,614	Dec. 25, 1877.	C. P. Hayes,	Brooklyn, N. Y.
200,361	Feb. 12, 1878,	S. R. Thompson,	Brookline, Mass.
201,938	April 2, 1878,	W. E. Nickerson,	Somerville, Mass.
206,494	July 30, 1878,	R. H. Shultis,	Kingston, N. Y.
210,095	Nov. 19, 1878,	W. Chicken,	Chelsea, Mass.
211,666	Jan. 28, 1879,	W. E. Nickerson,	Somerville, Mass.
211,798	Jan. 28, 1879,	Wm. Shaw,	Kingman, Me.
220,274	Oct. 9, 1879,	Wm. Chicken,	Chelsea, Mass.
220,945	Oct. 28, 1879,	C. P. Ryther,	Carthage, N. Y.
221,870	Nov. 18, 1879,	Wm. Shaw,	Kingman, Me.
229,205	June 22, 1880,	S. R. Thompson,	Brookline, Mass.
		S. W. Johnson,	West Medford, Mass.
234,324	Nov. 9, 1880,	D. Obrien	Oswayo, Pa.
238,923	Mar. 15, 1881,	S. Kullman,	San Francisco, Cal.
249,825	Sept. 13, 1881,	W. Chicken,	Chelsea, Mass.
264,152	Sept. 12, 1882,	J. C. Hagerty,	Santa Cruz, Cal.
282,771	Aug. 7, 1883,	L. F. Reed,	Hornellsville, N. Y.

Process for preparing Tan-bark for use, which consists in crushing the Dry Bark and reducing it to thin flakes by passing it between rollers under heavy pressure after it has been ground.

It is well known to those engaged in tanning that it is difficult to extract all the tannin from bark when used in the ordinary way in tanneries; and as tan-bark is becoming constantly more difficult to obtain in the required quantities, and consequently more expensive, it is very desirable to have some means by which the tannin may be more effectually, and also more quickly, extracted from the bark, and to accomplish this is the object of the present invention. Ordinarily the bark is simply ground in a bark-mill, and then leached in vats; but when so used the cellular structure of the bark is not destroyed or broken up, and the consequence is that, even though the bark be leached for a long time, more or less of the tannin is still retained in the cells of the bark, and is thereby lost.

In Figs. 31 and 32 there is illustrated a simple form of machine for breaking up the cellular structure of bark, invented by Mr. Byron Holbrook, of Kenosha, Wisconsin.

Fig. 31 is a perspective view and Fig. 32 a transverse vertical section of a machine designed for treating bark in accordance with this method. The machine consists of the rollers, *A*

and B, mounted in a suitable frame, the roller B being mounted in fixed bearings, while the roller A is mounted in adjustable

Fig. 31.

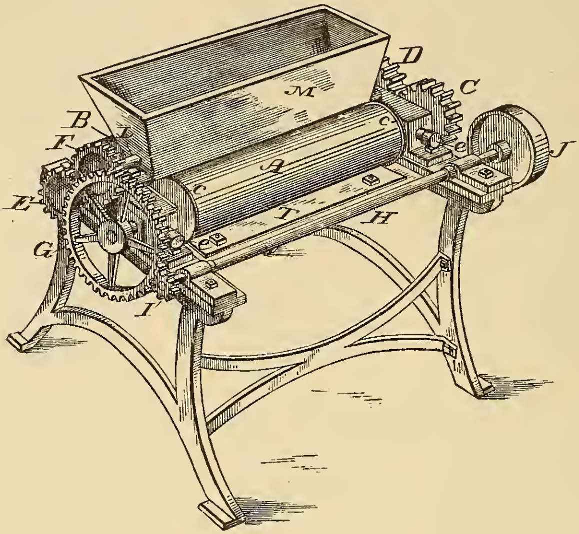
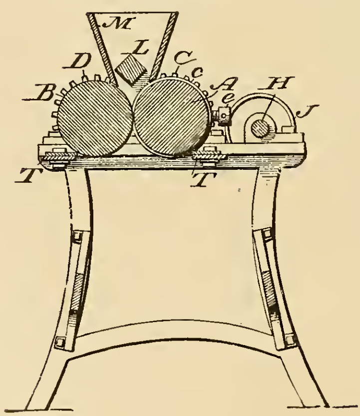


Fig. 32.



bearings, having set-screws, e, or equivalent means for regulating the pressure at will. These rollers carry at one end gear-wheels, C D, while the roller A has at its opposite end a gear-wheel, G,

with which engages a pinion, *I*, secured to a counter-shaft, *H*, which carries at its opposite end a pulley, *J*, to receive a belt from the engine or driving shaft, and by which motion is imparted to the two rollers. A wheel, *E*, is secured to the opposite end of roller *B*, and arranged to engage with a wheel, *F*, secured to the end of a feed shaft, *L*, which extends lengthwise through a hopper, *M*, secured above the rollers, as shown in Figs. 31 and 32. One of the rollers, *A*, is provided at each end with a radial flange, *c*, which fits into a corresponding recess on the ends of the roller, *B*, the object of which is to prevent the bark from working or being crowded out from between the rollers at their ends. Underneath each roller is arranged a scraper, *T*, which extends the entire length of the face of the roller for the purpose of removing all adhering particles of bark and gummy matter, with which they would otherwise soon become coated. These scrapers may be made adjustable.

As shown in Fig. 32, the feed-shaft consists of a rectangular metallic bar, the angles of which, as it revolves, force the bark between the rollers with a constant and uniform motion. If preferred, a ribbed roller may be used for this purpose. The rollers are shown so geared that they will revolve with uniform speed; but it is obvious that they may be arranged to rotate at different velocities, and the inventor proposes to so use them, especially when three or more rolls are used together, the more rapidly rotating roller having the effect of tearing or pulling the fibre asunder, thus tending to disintegrate as well as to compress and crush the bark. It is preferable to use rollers of comparatively small diameter, for the reason that they will operate more effectually, as only a smaller portion of their surfaces will act at any one instant upon the bark that may be between them.

In preparing the bark it is generally first ground in a bark-mill in the usual manner, and then passed between the rollers in the manner described, care being observed to have the rollers so adjusted as to apply a very strong pressure to the particles of bark as they pass between them. The bark will pass from the rollers in the form of a thin sheet or thin flakes, with its cellular structure completely broken up or destroyed, so that it

is claimed to be in a condition to readily yield up its tannin far more effectually, and in much less time than when prepared in the ordinary manner or merely ground.

SECTION II. IMPROVED BARK-CONVEYER.

This invention, which was patented May 1, 1883, by Mr. Oliver A. Zane, of Peabody, Massachusetts, relates to the endless chains and lags or devices connected therewith for conveying bark or various other matters from one position to another, it being specially useful for what in tanneries are termed "ground-bark conveyers," each of which in the main consists of an endless chain and a series of lags or bars, such lags or bars being arranged at equal distances apart and fixed or held to the chain, and the latter being extended around and supported by two spider or sprocket wheels. The conveyer so constructed is arranged to extend within a trough, through which, lengthwise of it, the chain in moving drags the lags and causes them to force along with them the bark or material to be transferred from one position to another or higher one.

Fig. 33 is a top view, Fig. 34 a longitudinal section, Fig. 35 a side view, and Fig. 36 a transverse section, of part of a conveyer containing Zane's improvement. Fig. 37 is an edge view of one of the links of the endless chain of such conveyer. Fig. 38 is a rear elevation, and Fig. 39 a front elevation, of one of the lags of the conveyer.

Previous to this invention it had been customary to construct certain links of the chain with ears extending from them and formed as shown in Figs. 40 and 41 at *a a*, the lag being fastened to the link by screws passing through the ears. These ears are very liable to become broken from the link, and thereby render it useless, and to necessitate the substitution of another, frequently at considerable expense, inconvenience, or loss to the tanner. With this invention the links of the chain are all alike and require no such means of connection of any of them with a lag, which may be attached to any one of them throughout the chain. In Figs. 33, 34, 35, and 36, these links are shown at *A A A* and a lag at *B*. Each link tapers lengthwise

Fig. 33.

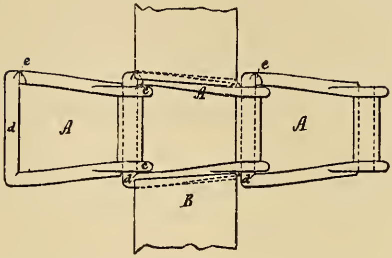


Fig. 34.

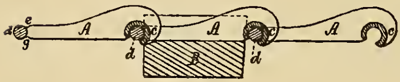


Fig. 35.

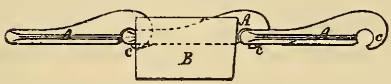


Fig. 36.

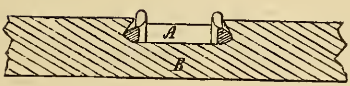


Fig. 37.

Fig. 38.

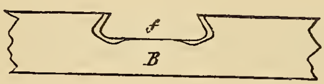


Fig. 39.

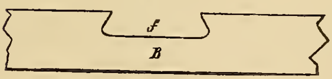


Fig. 40.

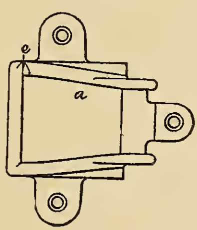
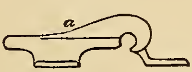


Fig. 41.



and crosswise; or, in other words, it is not only dovetailed in form lengthwise of it, but is also dovetailed transversely of it, as represented. It is hooked, as shown at *c*, at one end to clasp the

cylindrical end part, *d*, of the next link, each link being notched as shown at *e* and *g*, to enable it to be coupled with or uncoupled from another link. The lag *B* has made in it a notch or recess, *f*, to receive a link, such notch or recess being tapering or dovetailed both lengthwise and transversely of it to receive and fit to a link, which, previous to being engaged with its two next adjacent links, between which it is to extend, is to be placed within the notch or recess. Instead of this double dovetailed notch or recess being formed immediately within the bar or lag, it may be in a block or piece of metal screwed or fastened to the lag. While the dovetails of the link will keep the lag from slipping off the link in one direction transversely and in another lengthwise of it, the next link, by extending transversely beyond the lag-link, as shown, will prevent the lag from slipping off its link in the opposite direction longitudinally of the link. Thus by having to the lag a double dovetailed recess or link-socket, as described, and by having the chain-links made as represented, it is possible not only to readily adapt a lag to any link of the chain, but also to keep it in place without any screws, ears, or other fastenings, as heretofore employed; and when a tanner is provided with auxiliary links he can, in case of breakage of any one of the chains, readily supply its place with another.

Instead of a lag, a bucket may be used, and be provided with a double dovetailed recess or link-socket, as described, to receive a link of the chain.

CHAPTER XII.

LEACHING TAN-BARK—THE KINDS OF LEACHES EMPLOYED—BUILDING ROUND LEACHES—FILLING AND RUNNING THE SPRINKLER LEACHES—THE "BARKOMETER"—PURIFYING EXTRACTS OF BARK—OBTAINING TANNIC ACID IN ACICULAR FORM—LIST OF AMERICAN PATENTS FOR PROCESSES AND APPARATUSES FOR LEACHING AND MAKING EXTRACTS OF TAN-BARK.

SECTION I. THE KINDS OF LEACHES EMPLOYED.

THE best method for leaching or extracting the tannin in a perfect state, from tan-bark, has been for a long period eagerly sought after by tanners, and at the present time we have a great number of ways for performing this operation; in some of which sulphuric acid, blood, electricity, etc., are the active agents, but the usual manner employed by tanners is to remove the desired soluble portion of the ground bark by filtering, using water as a solvent.

The lixiviation is commonly conducted by one of three methods: in vats of various forms, but generally they are either round or square, and by one system the water is forced through the ground bark either from the bottom or the top by pressure obtained sometimes from a tank placed above the leaching vat, the altitude of which regulates the intensity of the pressure.

In a second method the tannin is extracted by forming a nest of leaches or placing one above the other, and then heating the bark and liquor contained in the top leach, and allowing the liquor to fall upon the lower leaches, and thus the bark is saturated and allowed for a time to remain stationary.

The third form, and the one now usually employed in all large tanneries in this country, is termed the sprinkler leach, which manner of leaching was invented by Messrs. Allen and

Warren in 1862, and by this method the water is made to percolate through the bark.

In the first mode the leaches are commonly divided into sets, and the number of leaches in a set accords with the working days of the week, and one fresh leach of each set is filled each day, and the heat is usually applied only to the back or weakest leach, thus allowing the strong liquor when it enters on the head leach of the set to be in a comparatively cold state, and thus leaving a large amount of impurities behind when it goes upon the leather in the yard from the head leach without further cooling.

Leaches of this kind may be constructed of either square or round form; but the square is best when placed in the ground, and then they should be on a level, and faithfully filled around with clay or loam, and should be in area 6x6, 8x8, 10x10, 12x12, or 14x14 feet, etc., but when the leaches are to be placed above ground, the round form is best; the size of the vats in the tan-yard regulating the capacity.

The best material from which to construct leaches of this kind is pine or hemlock plank of good thickness, which should not be less than two inches, and the planks should be well battened together and corked.

The second form or "douse" leach may be either round or square of any size, and it may be filled with bark and the liquor, or water run on, or the bark may be run on with the liquor by floating it from the mill, and the heat for this form of leach may be applied in any of the usual ways, either by inserting steam under the false bottom, or if it is desired, the water or liquor may be heated previous to running it on. But as by this method the liquors in the yard are diluted, it should be avoided in heavy tannage, and this is not generally considered by our best tanners to be so satisfactory, as either the press or sprinkler methods.

The Allen & Warren sprinkler is only applicable to round leaches, but there are other forms of sprinklers which leach the bark in vessels irrespective of their shape.

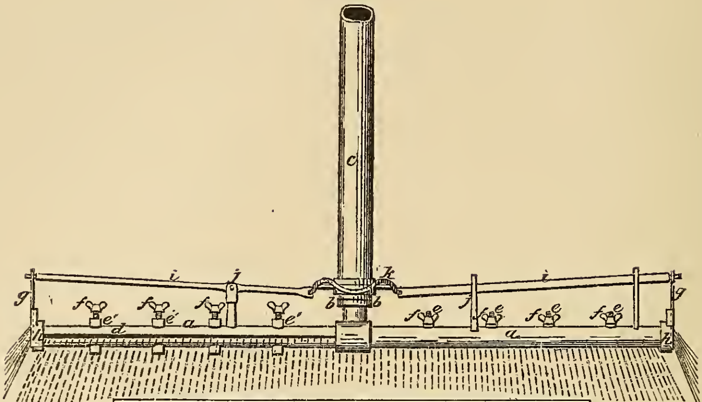
The object of the invention shown in Figs. 42 to 45 is to provide an apparatus for the automatic distribution of fluids for

leaching, and to render such distribution uniform over the surface of the material; while at the same time providing means for regulating the quantity of the fluid so distributed without decreasing the head pressure, velocity of flow, or speed of the distributing apparatus, and to render such distribution of the fluids uniform without regard to the shape of the leaching-vessel. These are the distinctive features of the invention, which consists in laying the fluid in a thin unbroken sheet, increasing in quantity in proportion to its distance from the axis of rotation, by means of fissures made in the opposite sides of the distributing-arms, and increasing in width toward their outer ends, while the outlet capacity of these distributers can be increased or diminished, and the volume thereby regulated without any change in the pressure, the velocity of the discharge, or in speed of the apparatus. The invention, which is that of Johnson, also consists in the combination, with automatic-distributing arms, of automatic gates or valves at the ends thereof, operating to open vents or fissures, at stated intervals during the revolving motion of the arms, for the purpose of projecting the fluid over an increased area of the leaching-vessel, such as the spaces formed by the corners of a square or many-sided vessel. Thus there is effected an equal distribution of the water or fluid over the whole surface of the material without regard to the shape of the vat; the opening of the gates being, of course, governed by the shape of the vat, and the means for effecting their opening being also made to conform to the movement of the gates.

Fig. 42 represents an elevation of a sprinkler for leaching, embracing this invention; Fig. 43 a plan thereof, showing the application to a square tub; Fig. 44 an end view; and Fig. 45 a cross section.

The sprinkler consists of two revolving hollow arms, *a*, of thin metal, suspended by a loose joint, *b*, from a fixed conduit, *c*, leading from the head or reservoir. These arms extend equidistant from the conduit, and are split to form narrow openings or fissures, *dd*, on opposite sides from which the fluid issues in thin sheets, and by its action causes the arms to revolve, discharging the leaching-fluid into the vat; and in order that this

Fig. 42.



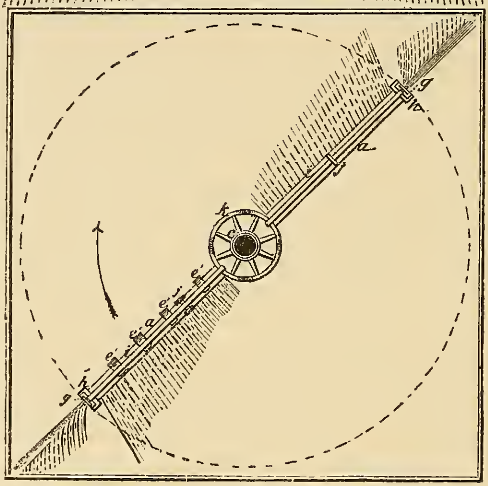


Fig. 43.

Fig. 44.

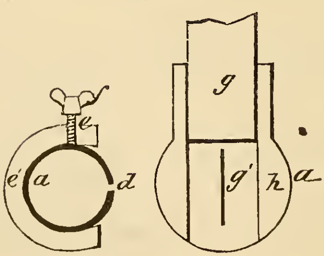
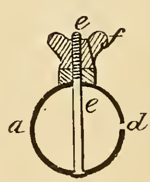


Fig. 45.



discharge may be uniform, and in proportion to the increasing area of the tub from the centre, these fissures are made to gradually increase in width from the conduit to the ends of the arms, as shown in Fig. 42. To increase or diminish the width of the distributing-fissures, the inventor employs adjusting-screws, *e*, passing vertically through the hollow arms, being riveted therein at their lower ends, and provided with thumb-nuts *f*, at their upper projecting ends, so as to bear upon the upper section of the split tube, and draw the sections together, or allow them to open as the nuts *f* are turned, the arms for that purpose having sufficient spring. These adjusting screws are arranged at such intervals as to effect the desired width of the discharging-fissures. Instead of having the adjusting-screws to pass through the arms, they may be embraced by yokes e', through the upper ends of which the screws *e* pass, so as to bear upon the upper side of the arms. By this means the fluid sheet is increased or diminished in thickness, or volume uninterruptedly from the centre to the extremities of the arms, and the material is thereby evenly and uniformly sprayed in proportion to its increased bulk from the centre of the tub, which is a matter of vital importance, to effect a uniform degree of leaching by percolation. In connection with the automatic continuous distribution of the fluid from the arms, the inventor also employs gates or valves, *g*, at the ends thereof, which are operated automatically at stated intervals to open fissures or jets to project sheets or streams of the fluid from the ends of the arms to sprinkle the angular spaces formed by square or many-sided vats. These end streams may be projected in the line of the arms or obliquely thereto, and the gates may be arranged to work in the ends of the arms in any suitable way to accomplish this purpose. In the drawings they are arranged to slide vertically in guides formed in heads *h*, on the ends of the pipes, and to open and close the end fissures g' by means of levers, *i*, connected with said gates, pivoted to short posts, *j*, on the arms, and connected to and operated by a serpentine cam, K, fixed to the lower end of the conduit, so that the revolving motion of the arms will carry the inner ends of the levers over the cam, and thereby cause the vibration of

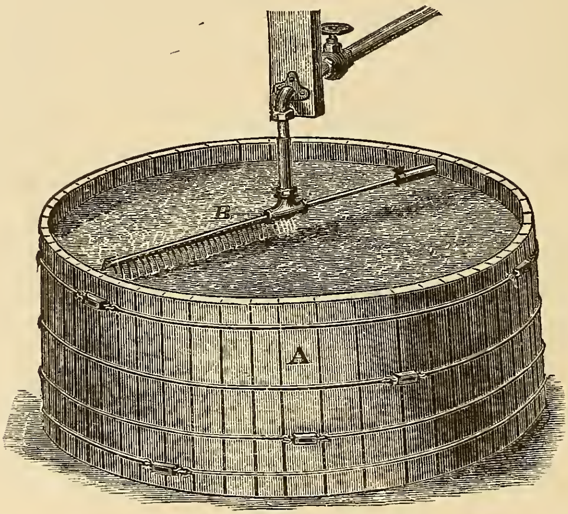
the levers, and the automatic opening and closing of the end gates.

The sinuosities of the cam must, of course, be made to conform to the frequency with which the gates are desired to be opened.

This sprinkler is by its construction adapted for use with either round or square vats, the only requirement for such change being the removal or attachment of the valve-operating levers, as with round vats the valves serve as closed ends to the arms.

Formerly two kinds of the sprinkler leach, the "centre post sprinkler" and "the hanging sprinkler," were in use, but the latter has almost entirely superseded the former arrangement.

Fig. 46.



In the Allen & Warren sprinkler the perforations gradually increase in size as they approach the edge of the leach, thus allowing a uniform distribution of the leaching fluid to be distributed over the entire surface of the bark.

The patent on the Allen & Warren sprinkler has now expired.

Fig. 46 shows a perspective view of a leach having the Allen & Warren "hanging sprinkler," the leach *A* is of the same

diameter at both top and bottom, the sprinkler *B* is of brass, and the holes in which are so adjusted as to furnish water or liquor uniformly to the entire surface of the bark in the leach, the pressure of the liquid maintains the sprinkler in motion, and the flow of liquor or water to the sprinkler is regulated by a valve.

The water or liquor is continually pressing and passing down in every part of the tub; and as the sprinkler is made to distribute steadily to every part of the bark an equal amount of leaching fluid, the strength is taken from the bark uniformly.

Section II. Building Round Leaches.

In building these round leaches pine lumber is the best to employ, but hemlock, spruce, or oak will answer very well, especially when the tubs are to be well sheltered. It should be partially seasoned—neither green nor quite dry. Use two-inch plank for the bottom and sides; it is not necessary to use thicker.

There is no need of matching or dowelling, as a good square joint can be made as impervious to water as the lumber itself, and without calking.

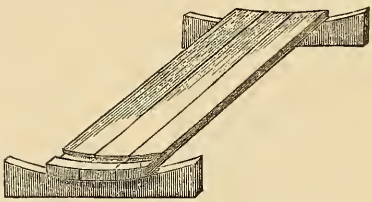
Commence by selecting a plank an inch longer than the interior diameter of the tub; make the centre of this the centre of bottom of leach, and with circling-stick begin to mark out the circle; continue to mark as the planks are, one after another, jointed and put in place, to guard against waste of lumber. When all needed planks are placed, apply a "set," and draw the whole well together. The joints should be made a little open across the centre, so that the "set" will bring the planks up to a good square joint; otherwise the joints will be open towards the ends. Screw board cleats on, withdraw the "set," strike a perfect circle, and cut it out. With gauge and plane make the bottom of one thickness at the edge. The cleats are to be taken off before the tub is finished.

The length of the staves or planks for the sides, should be ten inches more than the desired depth of tub above the false bottom; their width should not exceed eight inches for a leach ten feet in diameter, nor twelve inches for one sixteen feet in diameter.

Cut all the planks to the proper length first; number them, and lay them side by side in convenient portions; tack on a straight edge, and plane a groove or croze, one half inch deep, and of sufficient width to admit the bottom; the groove should be three inches from the end of the staves.

Take two pieces of plank about four feet long, and cut in each a segment of a circle of the same radius as the outside of the leach, and set them nearly the length as the staves apart. (See Fig. 47.) Joint the staves in these forms, take plank number

Fig. 47.



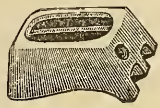
one, and bevel the edges slightly; bevel plank number two, to make close joint with number one; fit number three to number two, and so on until all the staves are fitted. In this way a perfectly round tub is secured. Either a saw or plane can properly be used to bevel the edges. The groove in the staves should be rounded out slightly, to conform to the circle of bottom of tub.

Having prepared a good foundation, place the tub bottom on it. Then set the staves up as numbered, and temporarily secure them to the bottom by a nail or two through each, at the crozing.

When wooden yokes are used to hold the hoops in place, they should be of hard wood, about three by six inches, and the length of the leach-staves. For a tub fifteen feet or less in diameter, two yokes are enough; for a larger tub, three yokes are recommended; to be placed at equal distances. The holes for the hoops should be bored so as to admit them at the edge of the tub, otherwise the hoops will force in the yokes so as to press the leach out of round.

Fig. 48 represents a cast iron yoke well adapted to take the place of the wooden one; it is hollow, and is quite light. The following is a good size: Length at the base, 5 inches; at the top, $3\frac{3}{4}$ inches; width and height, $2\frac{1}{2}$ inches.

Fig. 48.



Four hoops for leaches 14 feet and less in diameter, and five hoops for larger tubs, are advisable. The lower third of the tub will have to resist quite as great pressure as the upper two-thirds, and the hoops should be placed accordingly. Thus, when boring the yokes for four hoops, have one six inches from the top, and another six inches from the bottom of the staves, a third midway from top to bottom, and the fourth half way from the central hoop to the bottom of the staves. Use $\frac{5}{8}$-inch and $\frac{3}{4}$-inch round iron for the hoops, the larger size for leaches over 13 feet. It is found most convenient, without increasing expense, to make the hoops in parts, as shown in Fig. 49. A hook

Fig. 49.

on one end of the short-threaded piece which passes through the yoke is inserted into a similar hook, or an eye, of the long semi-circular hoop which connects the yokes.

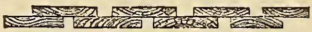
To complete the tub, the threaded ends of the short pieces of round iron are thrust through the yokes, the washers and nuts are put on, the yokes placed against the tub and connected by means of the longer parts of the hoops, and the whole drawn in place with nut and wrench.

The simplest, and a very good, false bottom is made of a single thickness of one and one-fourth inch narrow boards, placed about one-quarter of an inch apart, and the edges slightly bevelled, so the opening shall be slightly larger on the under side.

Another way, which requires a little more care and lumber in construction, is to lap one-inch rough boards, six or eight

inches in width, as shown in Fig. 50. The upper boards are placed about one inch apart, the under boards about two inches apart. Scantling, two inches by three, should be laid at intervals of twelve to eighteen inches, to support the false bottom, which will thus be three inches above the true bottom. The scantling should be notched on the under side to admit the free passage of liquors.

Fig. 50.



A substantial flooring about the leaches, near the top, is always useful. Whenever, through careless work, the tops of the leaches are liable to get out of round, a flooring will keep them in form.

To find the capacity, in cubic feet, of a round leach of any size, multiply the square of the diameter in feet by the decimal .7854, and the product by the depth in feet, and to find the capacity in cords divide this product by 128. For example: A tub 12 feet in diameter and 6 feet deep will hold $12 \times 12 \times .7854 \times 6 = 678.5856$ cubic feet $= 5.3$ cords.

The following table shows the capacity of round leaches of many sizes. The exhibit of material and labor needed in making them is so full that the tanner can readily tell the cost. Ample allowance is made in the table for waste of material. Five-eighths inch round iron weighs one pound to the foot; three-fourths inch, one and one-half pound to the foot.

As the leaches are never quite filled with bark, in figuring capacity an allowance of four inches in depth is made.

Interior diameter. Feet.	Depth above false bottom. Feet.	Lumber, board measure. Feet.	$\frac{5}{8}$-inch round iron. Feet.	$\frac{3}{4}$-inch round iron. Feet.	Number of days' work.	Capacity in cords. Ground bark.	Capacity per week in cords. Ground bark.
10	5	730	136	...	4	$2\frac{110}{128}$	$8\frac{74}{128}$
10	6	798	136	...	4	$3\frac{61}{128}$	$10\frac{55}{128}$
11	5	832	149	...	4	$3\frac{59}{128}$	$10\frac{49}{128}$
11	6	904	149	...	4	$4\frac{26}{128}$	$12\frac{78}{128}$
12	5	944	161	...	5	$4\frac{16}{128}$	$12\frac{48}{128}$
12	6	1022	161	...	5	$5\frac{1}{128}$	$15\frac{3}{128}$
13	5	1066	174	...	5	$4\frac{107}{128}$	$14\frac{65}{128}$
13	6	1150	174	...	5	$5\frac{112}{128}$	$17\frac{80}{128}$
14	6	1194	...	186	6	$6\frac{104}{128}$	$20\frac{56}{128}$
14	7	1284	...	186	6	$8\frac{2}{128}$	$24\frac{6}{128}$
15	6	1328	...	249	6	$7\frac{105}{128}$	$23\frac{59}{128}$
15	7	1426	...	249	6	$9\frac{26}{128}$	$27\frac{78}{128}$
16	6	1458	...	268	6	$8\frac{115}{128}$	$26\frac{89}{128}$
16	7	1561	...	268	7	$10\frac{60}{128}$	$31\frac{52}{128}$
17	6	1704	...	284	7	$10\frac{6}{128}$	$30\frac{18}{128}$
17	7	1814	...	284	7	$11\frac{105}{128}$	$35\frac{59}{128}$
18	6	1772	...	300	8	$11\frac{34}{128}$	$33\frac{102}{128}$
18	7	1888	...	300	8	$13\frac{32}{128}$	$39\frac{96}{128}$
18	8	2004	...	359	9	$15\frac{31}{128}$	$45\frac{93}{128}$

As the supply tank is simply a reservoir from which the water, or liquor, may be drawn to the leaches in a steady stream, the only necessary conditions are that it shall be water-tight and placed higher than the leaches. Its form, dimensions, distance from the leaches, and relative position, are matters to be decided from the plan of the tannery, and by the methods of operation in it.

It is well to have the supply tank as large as it can be conveniently, unless the pump keeps it always filled, and all needed heat can be applied at any time, in which case a very small tank is sufficient. An "over-flow" near the top will prevent any necessity for care lest the pump over-supply the tank.

A round tank is the cheapest and most durable, but frequently it is advisable to build in square or oblong form to economize space. It is better, of course, to have the reservoir near the leaches, if it can well be.

Steady pressure being desirable—to secure even flow to the sprinkler — the reservoir should be quite shallow ; three feet depth is enough for twelve feet diameter. Any tank in which heat is applied should, of course, have a close cover.

Liquors going to the leaches have to be strained to keep the

holes of the sprinkler from being clogged; and it is found best to strain in the supply tank. Fine brass-wire cloth makes the best strainer.

A loose partition in the tank secures the quiet, unagitated flow of the liquor to and through the straining cloth—agitation from the pump or steam tending to force bark or sediment through the strainer being thus neutralized.

Fig. 51.

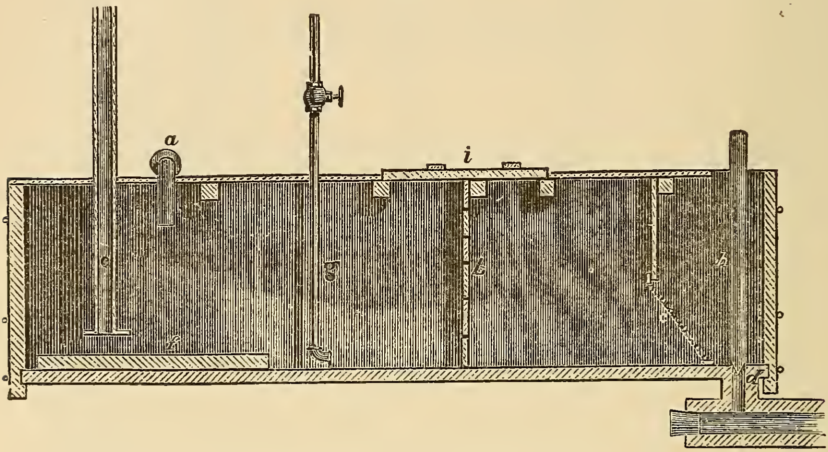


Fig. 51 shows vertical section of supply-tank, in which both direct and exhaust steam are used. All liquors enter from the pump-spout *a*, pass between the boards of the loose partition *b*, through the strainer *c*, and thence through the outlet *d*. Steam entering by the exhaust-pipe *e*, strikes the plank *f*, and is diffused throughout the tank. The direct steam-pipe is shown at *g*. A plug *h*, may be inserted or withdrawn to close or open the outlet *d*; a trap-door, *i*, is made in the cover, to allow ready access for clearing out, etc. The supply tank should always have a loose partition, but no cover is needed unless heat is applied in the tank.

To give head enough to cause the sprinkler to revolve freely when the supply in the reservoir is low, the tank should be set eighteen inches higher than the top of the leaches. When a pan-heater is used, the tank is to supply the pan; and that

should be high enough to give eighteen inches fall. In connection with an exhaust steam-box, like that shown in Figs. 52 and 53, the reservoir should be three feet above the leaches.

When the pan is used for heating, it should be about eighteen inches above the leaches, the supply tank being placed high enough to empty into it. The outlet of the pan should be about two inches from the bottom, that there may be neither an excessive amount of liquor in the pan, nor so little as to expose it to burning. In this way a broad thin current of liquor runs over the pan from the reservoir to the log leading to the leaches, saving heat as much as possible.

A valve between the supply tank and the pan will regulate the movement of the sprinkler perfectly when but one sprinkler is run at a time; and the valve near the sprinkler should, therefore, be wide open.

When two or more sprinklers are to be run at once, their movement is regulated by the valves near them; consequently, when a valve is used between the supply tank and the pan, care has to be taken that the supply is furnished only as fast as it can pass to the leaches. A better thing than the valve to regulate the flow to the pan is a gate in the tank, the movement of which is governed by a float in the pan, for the control is perfect, and no oversight is needed; the gate falls (closes) as the float rises, and rises (opens) as the float falls, the action being similar to that of the beam of a scale; any carpenter can make such an arrangement.

The steam can be applied either in the reservoir, or in a box between the supply tank and the leaches.

Heating in the supply tank is advantageous when it is desired to heat the liquors while leaching is not going on. Heat is thus stored up.

There are many advantages in heating in a box. The steam is condensed in a small, steadily changing body of liquid; consequently, any degree of heat up to the boiling point can be instantly had, and firmly held, without waste or special care. Useless dilution of good liquors, if any such are run to the leaches, is avoided. Exhaust steam, condensed in a suitable box, does not react on the engine; condensed in the tank, a

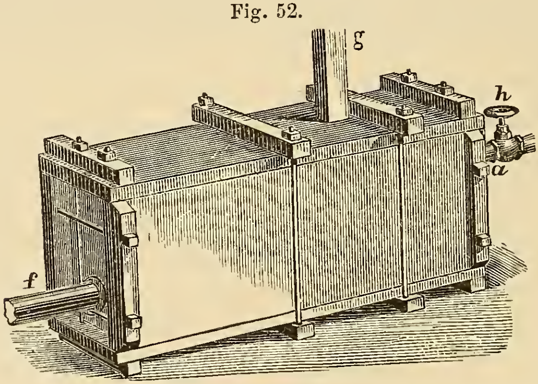
column of water is forced out of the exhaust-pipe at each stroke of the piston.

A full description of the making and working of a box suitable for exhaust steam is given below. When steam is the only motive power of a tannery, the exhaust will furnish all the heat required in leaching; the exhaust from the engine while grinding will usually give heat enough. If the exhaust is not sure to give 200° heat to the water or liquor whenever wanted, a direct steam pipe should be run to the box to supply any deficiencies.

A box suitable for direct steam has a square or round base of six or eight inches, and the same height as the supply tank. An escape pipe running into the reservoir is advisable. As the flow to the leaches is regulated near the sprinkler, the liquor is at the same level in the box as in the supply tank. The steam pipe should discharge against the bottom of box.

Fig. 52 gives a perspective view, and Fig. 53 shows a vertical section. It is well to have the box about four or four and a

Fig. 52.

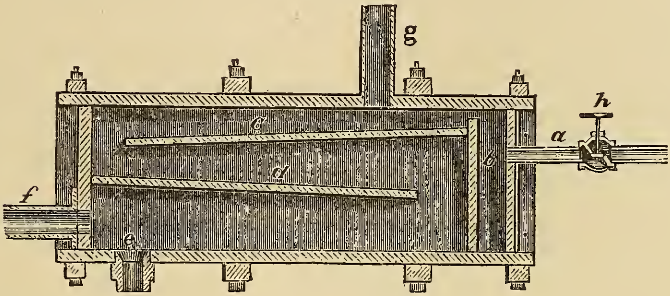


half feet long, one foot wide and eighteen inches high, inside, the outside should be of two-inch plank, and the shelves of one-inch pine or hard wood boards, the partition and shelves are mortised in.

Fig. 53 shows correctly the slope and relative position of the shelves. They must be placed with care, to make sure that the water passing over them shall form a sheet as broad as the box,

and of equal thickness in all parts. No nails or spikes are used, as the steam and metal in contact would burn the wood. Wooden yokes, iron bolts, or a combination of both, are used to strongly clamp the whole together.

Fig. 53.



Water or liquor entering the box at *a*, flows over the partition, *b*, upon the shelf, *c*, from which it drops to another shelf, *d*, and then to the bottom of the box; whence it runs through the outlet, *e*, into the conductor leading to the leaches. Exhaust steam enters by the pipe, *f*, and rising into the sheets of liquor dropping from the shelves, is instantly condensed. If direct steam is also used, it should enter near the exhaust; the waste pipe, *g*, leads into the tank, or elsewhere, any uncondensed steam. Whenever the volume of exhaust steam is found so large as to occasionally force back the liquor in the box,—a condition of things which rarely happens if the directions are followed,—boring a few holes in the lower shelf is the remedy.

The valve, *h*, regulates the flow to the box from the supply tank, it should also regulate the movement of the sprinkler, when but one is run at a time, in which case the valve near or over the leach should be entirely open.

When two or more sprinklers are run at one time, as the movement of each is controlled by the valve near it, and the flow for the aggregate supply is regulated by the valve *h*, care should be taken that the liquor does not back up in the heating box and cause irregular action of the sprinkler, unless an overflow to the junk is arranged. This may be done by inserting a

pipe or hollow plug, in the conductor leading from the box to the leaches, with outlet of such height that it will overflow whenever the liquor in the box is more than one or two inches deep.

The outlet *e* should have two or three times the area of the inlet *a*, as the liquor enters under much greater pressure than it leaves.

The supply of exhaust steam can be regulated easily and perfectly by means of a three-ways cock. Another good method for controlling the heat is tempering with water or liquor direct from the tank the hot water or liquor coming from the box; to do this, connect the tank with the conductor at a point beyond the steam box, and regulate the supply by a valve. Steam should not be run to the box except when wanted to heat.

A wooden conductor to the leaches is better than metal, for it is cheaper, retains heat better, and varies less with changes of temperature; it may be a hollowed log of two and a half or three inches bore, or board or plank spout, as most convenient. It is well, to save pipe, to place the log or spout about a foot to the right or left of the centre of the leach—the metal pipe connecting the log with the sprinkler should be nearly a foot long; as acid soon destroys galvanized iron, brass pipe should be used.

Fig. 54.

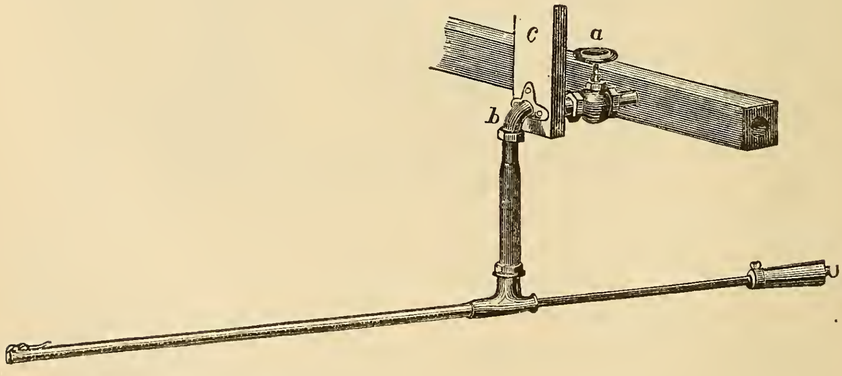
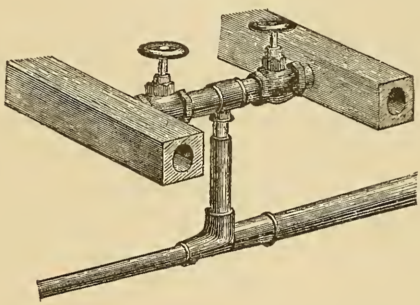


Fig. 54 shows a good method of connecting the log and sprinkler, and one which permits of but little irregular move-

ment. Care should be observed in first putting up the fixtures; by placing the rods so that there will be little or no play of the elbow, and so that the sprinkler will run on a level, is always profitable; the upper surface of the sprinkler pipe should be just below the edge of the leach.

The flanged elbow *b* is fastened to a 2 × 6 inch plank *c*, which is supported and braced from above. When the sprinkler is first run, assurance should be had that it is well balanced, so that the friction shall be as little as possible; by moving the weight in or out, and when in proper place holding it so by means of the thumb-screw, this balance is readily and permanently secured; this is important.

Fig. 55.



When it is desired to run hot and cold, or strong and weak, liquors, at the same time, the simplest arrangement of conductors is to place them side by side over the centre of the leach, fifteen to eighteen inches apart, and have the flow from them to the sprinkler regulated by an arrangement like that shown in Fig. 55.

Section III. Filling and Running the Leaches.

It is important to mix the coarse and the fine bark as it goes to the leach to prevent unequal action of the leaching fluid, and a little care exhibited in the occasional use of a shovel or scraper is necessary as the leach is being filled, and the tanner should also make sure by close examination of the tan when pitched

that the leach hand has learned to perform his duty in this respect.

When enough is in the leach to fill it within about four inches, the bark should be carefully levelled, and the sprinkler should move very near the surface, without exposing it to being hurried or delayed by any outside air.

When the bark goes directly from the mill to the leaches, dust in their neighborhood, and the necessity of attention to mixing the bark, can be avoided by bringing very small streams of hot water or liquor in contact with the bark just before it drops into the leach—simply to moisten the dust, and cause it to adhere to the larger particles. In a yard in which the first run is taken off cold, cold water or liquor may be used for this purpose in warm weather.

Bark should never be floated to the leach, as it parts with some of its tannin, and much concentration of liquors, unless hurtful doubling is resorted to, is impossible. When there is used cold water, or liquor, to float with, much heat is required to bring the cold, wet bark to the necessary temperature, and this cannot be done without waste of time and the use of a large amount of leaching fluid. To float with hot water or liquor is even less desirable, as the loss by chemical change is much greater.

The volume of water or liquor run to the leach is regulated by a valve, and the movement of the sprinkler is more or less rapid as the flow through the valve is increased or diminished; the velocity of the sprinkler may properly be taken as the comparative measure of the quantity of water or liquor given to the bark.

The leaching fluid, distributed steadily and evenly over the surface in fine streams, as it presses downward in the leach, drop by drop, is gradually absorbed by the bark; when the sprinkler is run slowly, as it should be, it takes nearly two hours to wet down the bark so that the liquor will commence running through the false bottom. The drops of leaching fluid thus pressing down are as numerous as the well-defined particles of bark in the leach. As each drop is slowly forced in turn, by succeeding drops, the entire depth of the bark, the

bark is rapidly penetrated, and its soluble portions are washed out, and in a comparatively small body of liquid.

Most of the strength of the bark should be taken out while running the sprinkler very slowly, for, although a little more time is required, the liquors are stronger. When the strong liquors needed in the yard have been run off, it is well to run the sprinkler more rapidly, to expedite the leaching; for in this way the heat of the leaching fluid will more rapily and uniformly penetrate the bark.

The sprinkler should never be run fast enough to cause the liquor to collect on the bark; a moment's reflection will show that it will make larger and more irregular channels if it is given to the bark faster than it can properly pass down.

If sediment collects in the sprinkler at any time, upon the valve at the end being opened, it will be at once washed out.

Liquor denser than water is an inferior leaching fluid; its operation is slower and not so thorough; bark can be exhausted in one-third less time with water only than with old liquors chiefly. A leach of hemlock bark, six feet deep, can be exhausted in twelve or fifteen hours by using water. The usual time is from eighteen to twenty-four hours when old liquors are employed.

The leaching should be finished by running through the sprinkler water, or a liquor no heavier, heated to near the boiling point. For oak bark, mediumly well ground, 180° F. heat is enough. For hemlock bark it is well to reach the boiling point, unless it is excellently ground, when 200° F. is enough. When such water or liquor has been run through the sprinkler for an hour, if the liquor coming from the leach shows no sign of tannin, the bark is leached, and may be cooled for pitching, with cold water.

Water being used as the leaching fluid, a cord of ground hemlock bark will give a cord of sweet, pure liquor, weighing about 14° by the barkometer, or the equivalent of it; as the barkometer simply shows density, a half cord of liquor weighing 28° is the equivalent, or two cords weighing 7°. With pure liquors, the barkometer is thus a reliable measure of value. In a few cases, owing to peculiar excellence of bark, a cord of

15° liquor is obtained; and sometimes, although rarely, inferiority of bark will reduce the result to the equivalent of 13° liquor. When sufficient heat is used to bring some of the gum into the solution, the strength of the resulting liquor is slightly increased. Oak bark has usually less strength than hemlock. Chestnut-bark will give ordinarily a cord of 11° liquor, or its equivalent, for each ground cord.

If old or weak liquors form the leaching fluid, whatever strength they take to the bark is added to the results above stated. It should be borne in mind, however, that an old liquor possesses less tannin in proportion to its density than a pure, new liquor, and that heating and straining it will so sweeten and purify it as to perceptibly reduce its strength; so it does not carry to the bark all the strength it apparently has in the vat, and when steam is condensed in it there is also some dilution.

The best way to concentrate the strength without doubling, is to start with a fair degree of heat and slowly increase it, as the leaching progresses, until the boiling point (212° F.) is nearly or quite reached. In mild weather 150° of heat is enough to have in beginning; in very cold weather 160° or 170° of heat should be used at the start, to counteract the chill of snow or ice on the bark.

The liquor is cold when it commences to run from the leach, but as the leaching goes on it gradually becomes warmer, until, just before the bark is exhausted, the temperature of the liquor running off is about 30° lower than that of the last, or hottest, water or liquor run on. The strongest and best liquor is that which comes a few minutes after the ooze has begun to run from the leach; from that time the liquor very slowly and steadily diminishes in strength, until it is utterly without tannin, and the bark is spent. It results from this that the strongest liquors are obtained with the least heat, and that the weak ooze to be run to the next leach, and thus strained and cleared in the bark, has in it any gum which may have been taken in solution, and a large proportion of the coloring matter taken up. It also results that the liquors can be run to make any strength desired, and that three-fourths of the strength of

the bark is taken from it in one-half the time required for the entire leaching.

When the leaching is conducted in this way, water, or absolutely spent liquor, will secure from each cord of hemlock bark, in a leach six feet deep above the false bottom, a quarter cord of liquor weighing 25° by the barkometer, and a quarter cord of each, 16°, 10°, and 5° liquor, about; or, a half cord of 20° and a half cord of 8° liquor. The weaker should, as before stated, be run to the next leach. The leaching of chestnut-oak bark, commenced with 120° to 140° heat, according to weather, and increased slowly to 180° to 200°, will give as good concentration. If liquor possessing some strength is run to the leach, the resulting liquors will gain to that extent; one-half or two-thirds of the gain will serve to increase the density of the liquors, and the remainder to increase their volume. Deeper leaches will secure a little more concentration, and shallower ones less.

Some tanners believe in getting gum into their yard liquors, to make sure they get from the bark everything of value in making leather. The sprinkler will give them all the gum they want, if they will commence leaching with water or liquor heated to 200° F. and will keep up the heat.

The time of leaching, by hot-water methods, ranges from twelve to twenty-four hours, according to the density of the leaching fluid, the fineness of the bark, and the regularity with which the heat is advanced; but leaches deeper than six feet above the false bottom require more time.

Whenever it is desired to take from bark the larger portion of its tannin with the use of little or no heat, the advantages of the Allen & Warren system are just as manifest as in the use of hot water; for, without doubling any strong liquors, the greater part of the strength of the bark can be rapidly obtained by using, not exceeding, 80° F. of heat—the summer heat of river water—and in as strong solutions as can be had in any other way of cold leaching with many doublings. The liquors thus obtained by the sprinkler are very clear, have less color, and are much purer, having more tannin for the same density.

Using water at 80° heat, the leach being six feet deep above

the false bottom, the first half cord of liquor from each cord of ground bark will weigh 13° or 14°, and its heat will not exceed 70°; the later ooze becomes slowly and steadily weaker, unless the heat is augmented. By running to the leach partially spent yard liquors, or the weaker liquors from the previous leach, the greater portion of the strength of the bark can be got in liquors ranging from 20° to 16°. When the ooze running from the leach is too weak for yard uses, by running hot water or spent liquor through the sprinkler the remainder of the strength can be rapidly taken out; the liquors thus obtained with heat, when sufficiently cooled, should be used on the next leach, where they produce sweet, clear liquors, being cleared of all excessive color in passing through the bark. Union leather tanners should bear in mind that old liquors are more or less sweetened by passing through the bark, even when heat is not used, and if they rely upon the liquors alone for acid properties in the handlers, they will find them better developed in half-spent lay-away liquors than in those fresh from the leach.

The size of the leach or leaches should, of course, depend on the amount of bark required to meet the demands of the yard, but it is seldom advisable to build a leach less than ten feet in diameter, chiefly on account of inconvenience in pitching, or larger than sixteen feet in diameter, arising from the considerable bulk; yet these sizes are as good as any other when adapted to the capacity of the yard.

It is better to have two smaller leaches than one large one, as less time is required to fill one of the small leaches, and less to empty it, and their alternate use will supply the liquors required more frequently, and, consequently, more nearly as wanted, and storage of either fresh or spent liquor is saved.

When the capacity of two or more large leaches is needed, it is better to have them large than to have them smaller and more numerous, the difference being economy in tubs and fixtures, and simplicity of operation.

When receivers, or storage vats, are used, it is recommended, if practicable, to set the leaches high enough to admit of using them without first resorting to a junk and pump; and the

receivers may well be high enough to admit of their contents being drawn off to any of the yard vats.

In the receivers, the fresh liquors needed in the yard are always ready for immediate use, and an occasional necessity for keeping packs waiting for proper liquors is avoided, and yard room is frequently saved, and warm or hot liquors are more rapidly cooled. Junk room is reserved for the partially spent or weak liquors which are to go to the leaches.

There should be, in case of such use, a receiver, or a compartment in a receiver, for each grade of fresh liquors required in the yard, and to secure the more rapid cooling, as well as to avoid placing the leaches very high, the receivers should be quite shallow.

The table of capacity of round leaches previously given does not show how many cords of bark, as bought by the tanner, they will hold, for a statement of that sort would have to be so vague as to be without value. A large number of tanners get about sixty heaped bushels, or three-fourths of a cord of ground bark for each cord they pay for; few get less than this; few get much more; a few get even cord for cord.

When compact loads of bark, well taken from the tree and flattened by cross piling, are measured by the same rule as light loads of unevenly cut and well curled bark, the tanner has to find some reliable standard before he can tell how much bark he really gets for his money, how much he uses in securing a certain result, and whether he is doing better or worse than others. There is no more reliable standard, probably, than the measure of the bark when ground. The results from a certain amount of ground hemlock bark, by the Allen and Warren system of leaching, are exceedingly uniform, as the foregoing figures show.

By occasionally comparing the bulk of bark on the wagon or sled with its bulk in the leach, the tanner may always know not only how much he is getting on the average for a cord, but how one sort of load compares with another in value. His record might well show how many cords of bark, as bought, he used during any year; how many leaches were run, and, consequently, how many cords of ground bark his purchases

netted; and the amount and kind of hides worked in, and the amount and kind of leather worked out. From this he could readily ascertain important facts that not one tanner in a hundred takes the necessary course to find out.

Section IV. The Barkometer.

In the use of the hydrometer, or barkometer as it is commonly termed by tanners, it must be kept in mind that it is designed simply to determine the density of any fluid thicker than water, as compared with pure water. It does not indicate of what the fluid consists; the density, or specific gravity, of other heavy fluids can be shown just as readily as that of a solution of tannin, and be indicated on the stem in the same way. The purity, or comparative purity, of a tanning liquor being known, the barkometer will show its comparative value.

The barkometer is graded so that when it is placed in water at 60° temperature it will stand at 0°; and the tanning liquors to be weighed by it should be at the same temperature, but as fluids contract and expand largely as they are cooled or heated, if the liquor is warmer than 60°, the barkometer will indicate less density than it should; if colder, greater density. This shows the value of a thermometer, to be used in connection with a barkometer, as the sense of touch cannot be relied upon to indicate the degree of heat. Barkometers made of glass are more reliable than any others, for they expand and contract less, and although in preparing the liquors it is not uncommon also to judge of their strength by the taste, still this is not a good guide, and no tanner can afford to be without a barkometer.

It is perhaps necessary also to remark that this instrument is applicable only to freshly-made liquors; for otherwise confusion and want of confidence might ensue upon finding that it sinks, sometimes, to a corresponding degree in spent liquor, and which is owing to the fact that the alterations which tanning liquors undergo during use and exposure may not diminish their density, though they impair and destroy their tanning power.

Section V. Purifying Extracts of Bark.

Tan-bark extract, as it comes from the leaches, contains fine particles of bark and holds in solution resinous gums. Various modes of filtration have been unsuccessful, principally owing to the gums in solution choking the filtering material, and the gums prevent the deposit of the fine floating particles of bark and other foreign substances; hence a refined fluid extract has not heretofore been readily obtainable. Unrefined fluid extract of tan-bark ill performs the function of tanning hides, owing to the resinous gums and fine particles clogging the pores, and prevents or mitigates the penetration of the tannin extract. A refined fluid extract in which the gums and floating particles of bark, etc., have been removed is a desideratum, and has been long sought for.

The object of the invention shown in Figs. 56 to 62, and which is that of Bradley, is to remove by precipitation the resinous gums and floating particles of bark from the extract emanating from leach-tubs: and the invention consists, first, in the process of causing precipitation by concentrating the leached extract by artificial evaporation, then rapidly cooling the same, and passing the cooled concentrated extract through a series of troughs overflowing into one another, wherein the sediment is deposited, the pure liquor passing from the surface of the last trough into a reservoir at a lower level; second, in a cooler composed of an outer and an inner cylinder, having a tapering outlet, and an agitator-shaft, whereby a flow of cold water is passed between the cylinders, while the extract to be cooled passes through the inner cylinder, which has a central shaft with agitating-arms; third, in combination, a heater or evaporator, a cooler, and a series of pans arranged to overflow into one another for deposit of sediment during precipitation.

Figure 56 is a side elevation of the apparatus. Fig. 57 is a section of the pans, showing levels of extract in passing through the same. Fig. 58 is a plan of Fig. 56. Fig. 59 is an enlarged sectional view of the cooler. Fig. 60 is a section of Fig. 59 on line *x x*. Fig. 61 is a section on line *y y*, Fig. 59. Fig. 62 is an elevation of the combined apparatus, showing, in section, a heater

or evaporator (marked *M*) of any suitable construction, with steam-coil *N*.

Fig. 56.

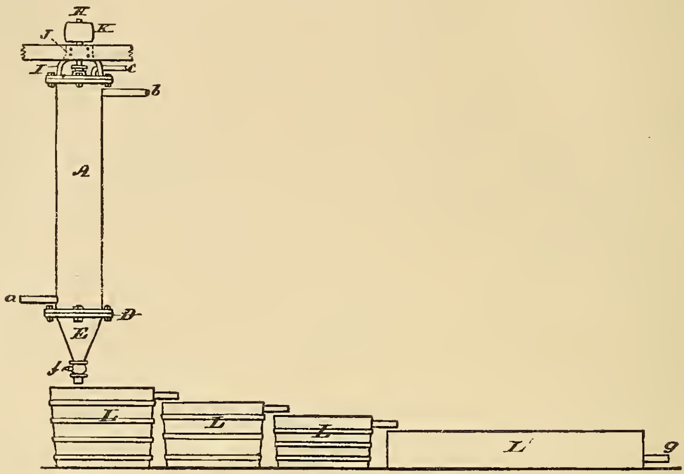
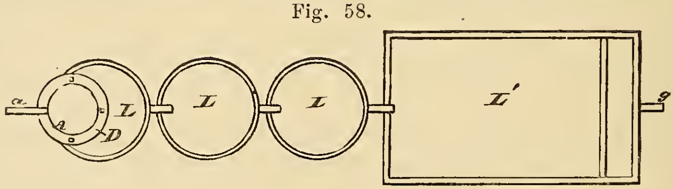


Fig. 57.

Fig. 58.



The extract, as obtained by leaching the bark in ordinary leaches or tubs, is conveyed to an evaporator, and concentrated by artificial evaporation to a density of from 7° to 11° of Baumé's hydrometer, 10° being the preferred density. It is then conveyed while hot to a suitable cooler and rapidly cooled to a temperature of from 60° to 80° F. From the cooler the condensed extract passes into a series of tubs of varying heights, arranged to overflow into one another, or the tubs may be of uniform height, arranged in steps, to receive the overflow from one to another and into a long shallow tank, and thence into a

Fig. 59.

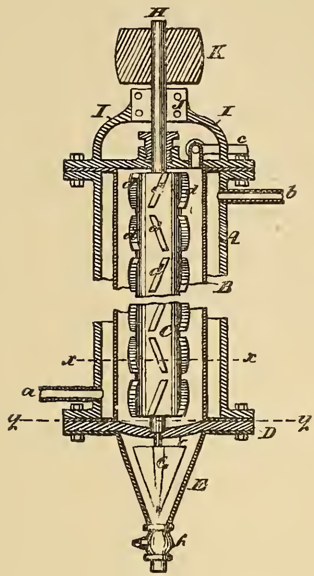


Fig. 60.

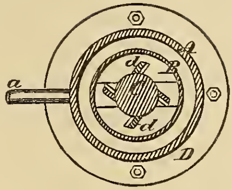


Fig. 61.

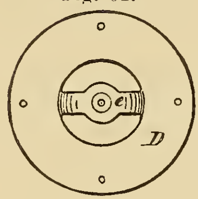
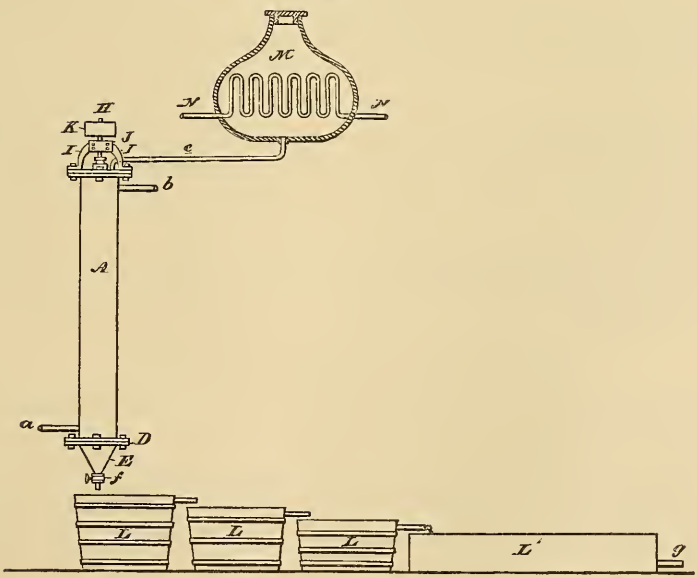


Fig. 62.



reservoir which receives the purified extract. The sediment is deposited in each tub, the grosser particles of foreign matter being deposited in the tub nearest the cooler, the finer particles, in corresponding ratio, being deposited in the succeeding tubs and tanks until the extract, refined from all impurities, flows into a storage-reservoir, to be concentrated for market, or into the tanning-vats, as may be desired; or the cooled extract may be run off into a series of tubs, as before described, each tub provided with a valved outlet, and the extract allowed to stand therein until the sediment is precipitated below the outlets, which are then opened, whereby the purified extract will flow into lower tubs.

If the extract before cooling is of less density than 9° or 11° Baumé, it will not deposit all the sediment in the tubs, and with increased density the deposit will only be partial, and if of the density as it comes from the leaches very little precipitation of sediment will be effected.

The lower the temperature of the extract when it comes from the cooler, until 60° or 70° F. is reached, the more sediment will be deposited in the primary tubs. If the extract is filtered before cooling, or if cooled as it comes from the leaches, scarcely any sedimentary deposit would be obtained.

It will thus be observed that the essential elements of this process are, first, the rapid cooling of the extract after it has been concentrated to a density of from 7° to 12° of Baumé's hydrometer, to cause the sediment to precipitate; second, in collecting the sediment set free by the cooler in a series of tubs and shallow pans, the extract flowing from one tub to another, each tub remaining nearly full to let the sediment collect, until it finally passes from the trough in an observable clear state.

Description of Bradley's Apparatus.

The leaches and evaporator need not be further described, as they are in ordinary use and well known to all persons skilled in the art of obtaining and concentrating extract of barks; but as a suggestion it might be stated that the screw form of evaporator used by Mr. H. McKenzie, and which is mentioned in the list of patients as No. 150,596, on p. 236, could, with but slight modifications, be employed in conjunction with this process.

A B are two concentric cylinders, the outer space forming a water-jacket or cooling chamber, of which *a* is the inlet, connected to a source of water-supply, and *b* an outlet to carry off the same, thus causing a circulation through the water-space.

The cylinder *B* is preferably of sheet-copper, and into the space between it and the revolving shaft *C*, with agitators *d* on it, concentrated extract, while hot, is admitted through the inlet *c*.

C is a hollow shaft provided with agitators *d*, and which shaft is stepped into a bridge *e*, of the end plate *D*, of the cylinder, said plate closing the water-space between the two cylinders and opening into a conical chamber *E*, attached to the bottom of plate *D*, the outlet provided with a stop-valve *f*.

The chamber *E* has internally a wing *G*, a little smaller than the conical chamber *E*, and is journaled therein by connection with the end of the shaft *C*, to revolve and keep the liquor agitated, and thus prevent the valve *f* from becoming choked. The agitators *d* are set inclinedly on the shaft in inverse order to cause counteraction.

The agitator-shaft *C* is driven by connection with a shaft *H*, passing through the end plate of the cylinders *A B*.

I are brackets carrying a bearing *J*, for the shaft *H*, which has a pulley *K*, for driving the same by a belt from any suitable motive power.

The concentrated extract becomes cooled in passing through the cooler and falls into a series of troughs or tubs *L*, arranged to flow or to overflow into one another consecutively, the last one discharging into a shallow trough *L′*. The concentrated extract, while in these tubs and pan, deposits sediment, the particles graduating in fineness from the first tub toward the trough *L′*, from whence it passes, by overflow-pipes *g*, into a suitable receiver, in a clear state, free from sediment.

Extract which has been concentrated to the ordinary density of, say, 30° Baumé, without being purified by this process, can be purified by diluting it with water to about 10° Baumé, and while hot passing it through the cooler and thence into the troughs to purify the same by precipitation of sedimentary deposit.

Section VI. Obtaining Tannic Acid in Acicular Form.

The invention shown in Figs. 63 and 64 is that of Holtz, and it relates to improvements in the production or manufacture of tannic acid for use in the various branches of the arts and manufactures, and more particularly in the manufacture of leather.

The tannic acid employed for technical purposes has been heretofore prepared for market by drying the viscous products of extraction containing the tannin in a high temperature, and then grinding the dried product and placing it on the market in a pulverulent form. This method of preparing tannic acid has material disadvantages and defects, one of which lies in the fact that the powdered tannic acid when brought in contact with atmospheric air is partially converted into gallic acid, and, of course, such a product has not the same value as the pure tannin. The presence of gallic acid or other foreign substance (the result of oxidation when the tannin extract is dried in too high a temperature) becomes at once apparent when the dried tannin is dissolved, it being impossible to obtain a clear solution. Another defect of this method of preparing tannin lies in the fact that the powdered product is exceedingly hygroscopic, cakes readily, and is then difficult to dissolve. It dissolves very slowly, and even the thoroughly-dry powdered tannin is apt to cake or form lumps, which impedes its solution materially.

The object of Holtz's invention is to remedy these defects and produce a practically pure and readily soluble tannin, better adapted for use in the arts and manufactures, and offering to the consumer a certain guarantee of its purity; and to that end the invention consists in the production of tannin in an acicular form by passing the inspissated tannin extract through a finely-perforated sieve, and reeling the thread into bundles, or by allowing it to drop from a height into a chamber, at the bottom of which it is curled into bundles and then broken up. In practice the inventor has found the apparatus illustrated in Figs. 63 and 64 best suited, though any other description of apparatus adopted to effect the same purposes may be employed.

Fig. 63 is a vertical section of the apparatus, and Fig. 64 a bottom-plan view of the reservoir.

In carrying out this process, take the inspissated viscous

solution of tannin (be this a watery or alcohol or other solution) obtained in the usual manner, and pour it into a vessel or

Fig. 63.

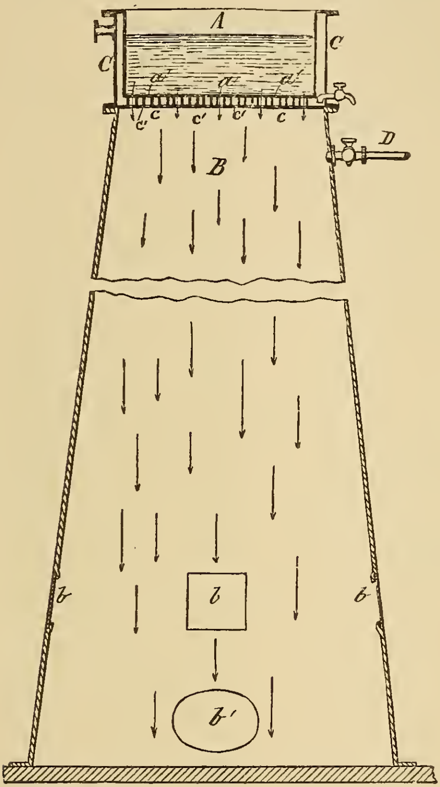
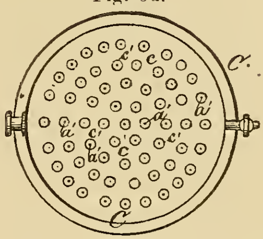


Fig. 64.



reservoir A, located some distance above the ground, lined with copper, zinc, tin, or other suitable material not affected by the tannic acid, and provided with a finely-perforated bottom a, so that the mass will pass through said bottom in thread-like form, and then reel the threads or otherwise form them in bundles. The more economical and easier way, however, is to allow the fine streams passing through the bottom of the reservoir A to flow from a height into a chamber and cool themselves on the bottom thereof in a dried state; and to that end it is best to employ a tower B, about 16 feet and 6 inches in height, with

one or more peep-holes b, and a man-hole b', the purposes of which are obvious.

The reservoir A is surrounded by a jacket C, into which any heat-producing medium (preferably steam) may be introduced to maintain the extract in the fluid condition required.

The bottom c of the jacket has a series of perforations, equal in number to the perforations a' in the bottom of the reservoir and conaxial therewith, but of greater diameter. To prevent the contact of the steam with the out-flowing extract the perforations are surrounded by small tubes c', secured to the under surface of the bottom of the reservoir and the upper face of the jacket-bottom. The use of these tubes c', surrounding the outflow-apertures, produces another and more important result—namely, the form-drying chambers, wherein the thread as it issues from the reservoir is brought in contact with a heat-radiating surface of great area as compared with the surface of the outflowing thread-like extract, and which dries this thread sufficiently to enable it to support its own weight for a distance of five meters before the thread reaches the bottom of the tower, being thoroughly dried by the air within the said tower during its progress to the bottom thereof, where it curls itself like finely-curled wool, and may then be readily broken up into needles.

It is preferable to make the tower air-tight and produce a vacuum therein by any suitable means, such as a force-pump connected with a pipe D, located at or near the top of the tower, whereby the pressure of the surrounding atmosphere upon the viscous tannin extract tends to force the extract through the perforations of the bottom of the reservoir, thus not only greatly accelerating the operation, but also enabling a more concentrated solution to be employed than would be the case if the passage of the latter depended solely on its weight.

The tannin threads when cold are exceedingly brittle, and break into shining golden-yellow acicular fragments, and in this acicular form the tannin, owing to its brittle or glass-like condition, is not hygroscopic, will not cake, and a perfectly clear solution is obtained therefrom.

The tannin being prepared under the influence of a low temperature does not contain any products resulting from decomposition, such as above enumerated.

List of all Patents for Processes and Apparatuses for Leaching and making Extracts from Tan-bark, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	Aug. 10, 1791.	J. Biddis and S. T. Bedwell,	
	Oct. 20, 1812.	J. W. Fessenden,	Walpole, N. H.
	April 5, 1823.	W. Knapp,	Milford, N. Y.
	April 11, 1825.	J. Niles,	Guilford, Vt.
	Mar. 15, 1825.	W. Lober,	Philadelphia, Pa.
	Nov. 1, 1828.	W. Coburn,	Gardiner, Me.
	Nov. 7, 1835.	O. Batchelder,	Bedford, N. H.
836	July 12, 1838.	A. A. Hayes,	Roxbury, Mass.
1,035	Dec. 15, 1838.	G. W. Klein,	Boston, Mass.
13,403	Aug. 7, 1855.	G. W. Smith,	Nanticoke, N. Y.
14,418	Mar. 11, 1856.	A. Steers,	Medina, N. Y.
Reissue 2,142	Jan. 2, 1866.	A. Steers,	Medina, N. Y.
27,859	April 10, 1860.	J. Connell,	Port Huron, Mich.
29,143	July 17, 1860.	J. Connell,	Port Huron, Mich.
34,873	April 8, 1862.	J. Brainerd and W. H. Burridge,	Cleveland, O.
Reissue 2,523	Mar. 19, 1867.	J. Brainerd and W. H. Burridge,	Cleveland, O.
36,048	July 29, 1862.	Wm. H. Allen and O. Warren,	Freyburgh, Me.
Reissue 1844	Jan. 3, 1865.		
41,782	Mar. 1, 1864.	S. W. Pingree,	Lawrence, Mass.
47,393	April 25, 1865.	J. Chilcott,	Brooklyn, N. Y.
45,421	Dec. 13, 1864.	J. McGeary,	Salem, Mass.
48,365	June 27, 1865.	J. M. Caller,	Salem, Mass.
50,636	Oct. 24, 1865.	S. W. Pingree,	Lawrence, Mass.
54,945	May 22, 1866.	F. W. Perry and J. H. Pierce,	Woburn, Mass.
57,218	Aug. 14, 1866.	N. S. Thomas,	Painted Post, N. Y.
64,321	Apr. 30, 1867.	B. Irving,	New York, N. Y.
64,322	Apr. 30, 1867.	B. Irving,	New York, N. Y.
64,323	April 30, 1867.	B. Irving,	New York, N. Y.
64,324	April 30, 1867.	B. Irving,	New York, N. Y.
64,325	April 30, 1867.	B. Irving,	New York, N. Y.
68,010	Aug. 20, 1867.	A. Steers,	New York, N. Y.
68,335	Sept. 3, 1867.	A. Appleby,	Brownfield, Me.
70,439	Nov. 5, 1867.	J. W. Jones,	Cumberland, Md.
71,765	Dec. 3, 1867.	C. Korn,	Wurtsborough, N. Y.
75,571	Mar. 17, 1868.	S. J. Patterson,	Bridgeport, Conn.
75,608	Mar. 17, 1868.	G. Warren,	Roxbury, Mass.
76,775	Apr. 14, 1868.	J. W. Jones,	Cumberland, Md.
81,643	Sept. 1, 1868.	T. W. Johnson,	New York, N. Y.

No.	Date.	Inventor.	Residence.
82,121	Sept. 15, 1868.	T. W. Johnson,	New York, N. Y.
82,739	Oct. 6, 1868.	C. H. Mosely,	Winchester, Mass.
83,389	Oct. 27, 1868.	T. W. Johnson,	New York, N. Y.
85,173	Dec. 22, 1868.	B. Irving,	New York, N. Y.
85,174	Dec. 22, 1868.	B. Irving,	New York, N. Y.
85,175	Dec. 22, 1868.	B. Irving,	New York, N. Y.
87,119	Feb. 23, 1869.	S. Snyder,	Cincinnati, O.
87,984	Mar. 16, 1869.	G. A. Starkweather,	Waymart, Pa.
88,678	Apr. 6, 1869.	N. S. Thomas,	Painted Post, N. Y.
88,807	Apr. 13, 1869.	J. Pickles,	Wigan, England.
90,848	June 1, 1869.	T. W. Johnson,	New York, N. Y.
92,455	July 13, 1869.	T. W. Johnson,	New York, N. Y.
95,009	Sept. 21, 1869.	L. C. England,	Philadelphia, Pa.
96,212	Oct. 26, 1869.	L. C. England,	Philadelphia, Pa.
96,345	Nov. 2, 1869.	J. Pickles,	Wigan, England.
102,832	May 10, 1870.	S. W. Kennedy,	New York, N. Y.
108,793	Nov. 1, 1870.	T. W. Johnson and A. W. Goodell,	New York, N. Y.
Reissue 4.531	Aug. 29, 1871.	T. W. Johnson and A. W. Goodell,	New York, N. Y.
111,730	Feb. 14, 1871.	H. C. Crowell,	Morgan, O.
118,956	Sept. 12, 1871.	W. Maynard,	Salem, Mass.
134,675	Jan. 7, 1873.	T. W. Johnson and A. W. Goodell,	New York, N. Y.
137,004	Mar. 18, 1873.	C. Korn,	Brooklyn, N. Y.
140,469	July 1, 1873.	P. M. Church,	Sault de Ste. Marie, Mich.
150,595	May 5, 1874.	H. McKenzie,	Marquette, Mich.
150,596	May 5, 1874.	H. McKenzie,	Marquette, Mich.
150,597	May 5, 1874.	H. McKenzie,	Marquette, Mich.
187,468	Feb. 20, 1877.	T. W. Johnson,	New York, N. Y.
193,120	July 17, 1877.	J. J. Johnson,	Columbiana, O.
218,212	Aug. 5, 1879.	R. R. Andrews,	Smithport, Pa.
230,398	July 27, 1880.	E. Bradley,	Three Rivers, Quebec, [Can.
231,035	Aug. 10, 1880.	P. Gondolo,	Paris, France.
231,489	Aug. 24, 1880.	Julius Holtz,	Berlin, Prussia.
245,006	Aug. 2, 1881.	G. B. Moore, Sr.,	Cincinnati, O.
245,142	Aug. 2, 1881.	J. Davis,	Allegheny, Pa.
253,802	Feb. 19, 1882.	M. Wise,	New York, N. Y.
258,573	May 30, 1882.	P. Gondolo,	Paris, France.
258,574	May 30, 1882.	P. Gondolo,	Paris, France.
259,555	June 13, 1882.	O. Kolrausch,	Vienna, Austria-Hung.
263,797	Sept. 5, 1882.	A. Mitscherlich,	Münden, Germany.
283,881	Aug. 28, 1883.	P. Gondola,	Paris, France.

NOTE.—For portions of the matter relating to building round leaches and filling and running the sprinkler leach, contained in this chapter, the author desires to acknowledge the source of his information, which has been derived from a valuable catalogue published by Messrs. Allen & Warren, now of Conway, N. H.

PART IV.

CHAPTER XIII.

WASHING AND SOAKING HIDES AND SKINS—PROCESSES FOR SOFTENING HIDES, SKINS, AND PELTRIES — LIST OF AMERICAN PATENTS FOR COMPOUNDS FOR SOFTENING HIDES — PROCESS FOR PLUMPING BEFORE DEPILATING.

SECTION I. WASHING AND SOAKING.

IN the manufacture of leather the hides and skins destined to be tanned or tawed and converted into this product are subjected to various preliminary operations, the nature, variety, and duration of which depend upon the condition of the hides or skins when they arrive at the tannery, and also upon the class of leather that it is desired to produce. The "green" hides are those from recently slaughtered animals, and are soaked for a short time in water so as to remove the blood and adhering dirt, and are to be well raised when taken from the soaking, and if to be soaked for a long period, it is necessary to handle them from time to time.

The dry hides are soaked for a longer period than the green hides, and afterwards they are worked in the hide-mill, and so through the whole class of hides, there are different processes to which they must be subjected. In order to achieve satisfactory results in every step of the production of leather, it is imperative that there should be similarity of state which must be such as will be conducive to success. Foremost among these demands, there must be a sameness in the condition of the hides at the beginning.

The proper selection of hides, according to variety, size, thick-

ness, and condition, is of course a difficult problem, but as these matters are to decide the final value of the finished leather, it is absolutely essential that the most intelligent judgment be exercised at this point, for if there be not proper consideration here there will be loss throughout all the subsequent processes, consequently a final diminution of profit. All tanners are, of course, not so situated as to make it expedient to so assort the hides; but where it is possible, the classification should be made, and the hides of the greatest substance should be picked out and first worked in, thereby allowing a simultaneous completion at each step of the process, by which arrangement it would be much easier to detect and rectify mistakes.

It is well known that during the continued submersion of hides in vats of water the variations in the temperature of the weather and of the water and in the quality and purity of the latter, which is constantly being rendered unfit for its designed purpose by the continued accumulation of decomposed particles of flesh and fibre from the hides, there is more or less damage and injury to the hides, which suffer a loss of gelatine and fibre and appear spotted in what are known as "black rot," black or yellow spots, and damage in the process of sweating or liming, usually called "pricks," "pitted," and "frieze." It follows that if these natural results of the necessary steps of procedure in tanning are overcome the product will not only have a clearer superficial appearance, but its texture and fibre will be more uniformly of natural thickness and of desired firmness than is now the case.

In the usual first step in the art of tanning—that is, soaking the hides in clean water—pricks, pitted, frieze, and black spots originate. The hide decomposes before it is properly softened, which decomposition is sufficient to cause the above-named injuries, and no subsequent use of saltpetre or any other restorative can prevent them.

The term "prick" indicates an appearance such as would be produced by puncturing the hide with pins, and this injury is produced by soaking for too long a time, especially in hot weather, and it may also be produced in a subsequent step in the art known as "sweating." "Pitted" indicates an appearance

much similar to the above, but the holes are much larger. "Frieze" is principally caused in the subsequent step of sweating when the grain of the hide is inclined to be tender and has the appearance of being scraped off. "Black spots" are small blotches of dark color, and when the hide is tanned, rolled hard, and finished, these spots cannot be buffed off, and sometimes cover the whole side of leather. They originate in soaking and sweating. As these injuries originate directly or indirectly in the soaking of the hides at the commencement of the process of tanning, the use of a preventive at that time is of great importance. Hence Mr. John W. Hammond, of Osceola, N. Y., who claims to have invented the following process of soaking, uses saltpetre in the first step in the procedure.

By subjecting hides, either dry or green, to the action of water containing a proper proportion of saltpetre or nitrate of potassa for a proper length of time and at a proper temperature, he claims that they are the better prepared to withstand the deleterious effects of the usual subsequent liming and sweating processes and of the process of plumping and coloring in the handlers.

The principle upon which this manner of soaking is based is that before subjecting the hides to the decomposing and destructive action of the sweating and liming processes, in order to swell and soften the fibre, to the end that the hair may be removed and the pores opened for the entrance of the tanning agents, this swelling and softening should be accomplished through the medium of an agency which will at the same time act to preserve the life and fibre of the hide, instead of hastening its waste and decomposition.

The use of saltpetre in tanning is not new, it having been already used as an ingredient in tanning liquor, but experience has shown that desirable results are not secured in so great measure by such use as when its effects are given solely and primarily and under the conditions hereafter stated.

In practice the use of this preparatory treatment depends upon circumstances, as to quantity, temperature, and time, that are within the discretion of the skilled tanner, and this from the variableness of the condition and quality of the hides to be

treated, the temperature of the atmosphere, and the state of the weather; but as a basis or rule of general application the following-mentioned proportions and particulars it is claimed are practical and beneficial in result, though changes may be made in them by reason of the before-mentioned conditional circumstances, so that the exact proportions, temperature, and time are not vital essentials. For twenty-five hundred pounds of dry hides and the same proportion of green hides use sufficient water to cover or hold that quantity of hides, and intermix with the water before putting them into it from one to six pounds of saltpetre, the same being dissolved in warm water and then added to the water in the vat, the hides being subjected to immersion therein, with more or less frequent handling in order uniformly to expose each hide to the full effects of the liquor for from two to thirty days, and at a medium temperature. It will be seen that the temperature of the liquor should be comparatively higher in cold and lower in warm weather, the proportion of saltpetre increased with the increased proportion or quantity of hides, as also the time of treatment, all of which is a matter of judgment in the province of one skilled in the usual methods of tanning.

Hides so treated it is claimed assume a plumpness and firmness, the pores are opened, and the hair-cells are softened and distended, rendering the subsequent liming and sweating processes shorter and more effective and the subsequent tanning by submersion less destructive to substance and fibre, and reducing liability to spot. Hides so treated it is claimed can be worked in the processes of soaking and sweating with much higher temperature of weather and water than by the ordinary well-known processes.

All grease should be removed from the hides during the soaking, or they will not sweat properly, and if grease is still present after the usual method of soaking and milling, then the use of soda-ash, potash, sal-soda, or an equivalent alkali is recommended, and in lieu of these hard wood ashes may be used in the soaks if more convenient, as these agents convert grease into a soap, which will wash from the hide very easily in the mill.

Small hides or kips, after being well washed and cleaned, are sometimes soaked by laying them in foul bloody water. This method, which is in use amongst white tanners, requires much attention, like every other process by means of which the hide is restored almost to its original condition.

It imparts a perfect softness to the hide, leads rapidly to the result, and is not costly; but it requires the greatest precautions.

Another method is the softening of the hide by "sweating," that is to say, heating it without fire and without steam, and of the sweating process, as generally employed, we shall treat in Chapter XV.

With regard to imported salted hides, a proper softening in water will do, and this water should be changed every now and then, so that the hides do not remain long in briny water, and care should be taken to rinse them thoroughly before placing them in the fresh water.

Of the influence of water upon the quality of the leather we have spoken in Chapter IX. Of the period which the hides and skins are allowed to remain in the soaks and their usual treatment for different classes of leather we shall enlarge upon in the descriptions of the methods of manufacturing sole leather, upper leather, Morocco leather, etc. It is not of course intended that the processes to which reference has just been made should be considered as dogmatic, for no two tanners treat hides in the soaks, sweating, liming, or other steps in tanning, in exactly the same manner and for the same period; some tanners advocate light soaking, while according to others the quality of the leather is improved in proportion to the duration of the soaking of the hides; but it is undeniable that when it exceeds a certain time the skin acquires a tendency to decomposition, and the quality of the leather is impaired.

The construction and operation of the hide-mill is explained in Chapter XIV., and is usually employed after the soaking of dry imported hides.

When the hides are dry the soaking should be continued longer, and that operation is facilitated by handling them often. The hides are to remain in water until they have become supple,

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and it is for the intelligence of the workman to determine when this point is attained. *Dried* and *salted* hides require a much longer soaking than those which have only been dried.

The working and softening of the dry hides in the hide-mill, or upon the horse or beam, are considered indispensable operations by every experienced tanner, in order to remove the stiffness and wrinkles, and are of course unnecessary for green hides.

When the hides have all been soaked and washed, and are sufficiently supple, after being worked in the hide-mill, they are returned and left in the water for six hours. In running water they may remain eight hours. Reference is here made exclusively to large hides, for cow skins may be left without danger for 24 hours, and calf skins 48 hours, being careful to observe the nature of the water and the temperature of the air. Too long soaking in the same water exposes the skins to the danger of putrefaction, and the rapidity of the decomposition is proportional to the amount of filthy matters contained in the water.

In some parts of France, hides from South America are placed directly in vats filled with lime-water and left for six to ten days, care being taken to work them in the usual manner at frequent intervals during the soaking. The skins are softened by the action of lime and rendered more easy to be handled. At this stage the defective parts may be detected, and sometimes they are so damaged as to be suitable only to manufacture glue.

Well-salted hides, but not dried, may be cleansed in 48 hours, but they can be left to soak three or four days without danger. They should be handled once a day. When taken out from the water for the last time they should be given a vigorous and thorough rinsing.

It is the usual custom in the manufacture of upper leather, after hides have been properly soaked, to split them into "sides;" previous to which operation they are drawn into a pack with the hair side uppermost, and then a knife is driven from the butt through the centre of the backs, which divides the hides.

Soaking Dry Hides in Running Water.

As there is still a large amount of soaking of dry hides done in running water, we give separate directions for conducting it.

The water should have a temperature not above 55° F. According to the prevailing arrangement, the dry hides are suspended by chains or ropes, or hung over a pole. After twenty-four hours they will be sufficiently soaked to be rinsed, after which they are bent apart and replaced in the water.

They are now rinsed every twelve hours, partly for the purpose of changing the position of the hides so that the soaking will be uniform, and partly to prevent mud and other impurities from settling upon them. After six days they are generally sufficiently soaked to allow them to be subjected to the sweating process; more than eight days' soaking being required only in rare cases; but this is of course dependent upon the nature and condition of the hides.

After the hides have been soaked and swelled so that they can be readily bent (especially the head), and the escutcheon has assumed a glassy appearance, they are removed from the water, it *being* of the *utmost importance* that in doing this, they are cleansed from all dirt and impurities. It is best to use for the latter purpose a worn-down broom, with which they, and especially the hair sides, are scrubbed until all dirt is removed and the rinsing water runs off clear.

After folding them in the middle and tucking in both ends, they are piled one upon the other until all are cleansed.

They are then thrown over a bench and allowed to drain off for a few hours, or over night.

Section II. Processes for Softening Hides, Skins, and Peltries.

Softening Dry Hides, Skins, and Peltries, by Soaking them in the Waste Water from Gas Works.

It is known to tanners that serious inconvenience exists in the processes used for the purpose of softening dry hides. The one commonly employed consists in immersing them in a bath

of water, together with various subsidiary aids, such as scraping, beating, working them in the hide-mill, etc.

The serious inconvenience experienced in this mode is the well-known liability of the hides to putrefy before they are sufficiently softened to be ready for the lime process.

Another objection to the use of the common method is that in cold weather the length of time required for softening is so great as to be a serious loss to tanners. Then, again, there is a risk of destroying the hides if softened during very warm weather.

It is claimed that by the use of waste gas-water the above objections can be obviated.

Barron's Process.

The agents which this inventor claims to be the most effectual for softening dry hides, skins, and peltries are: The refuse liquid of gas-works in the refining process; gasoline; and coal-tar. The refuse liquid is employed either alone or slightly diluted with water. When gasoline is used it is diluted with water in about the proportion of one part gasoline to twenty parts water. But exactly the best proportion cannot be definitely stated, inasmuch as the strength of the soak will vary according to circumstances, such as the character of the hides and the state of the weather, etc. The above proportions, it is stated, will generally answer, but may with safety be somewhat varied by slightly less diluting in winter and more in summer. The coal-tar, however, will not answer when taken alone, nor is it sufficiently soluble in water to be made available with water only. To be used effectively it must, by the aid of an alkali, be dissolved in water. Caustic soda will answer as the alkali for the above purpose; and the following proportions, it is claimed, will give beneficial results—to wit: five gallons coal-tar, three pounds caustic soda, and one hundred gallons of water.

Each of the above mixtures, it is claimed, contains substantially similar active agents, viz: water, alkaline matter, and antiseptics. The alkalies of the above are mainly ammoniacal

salts in solution. The antiseptics consist principally of soda carbolate and cresylate.

The action is as follows: The water is the principal softening agent; the alkalies remove the fatty parts of the hide, and have a peculiar softening effect upon the hide, and, when taken in connection with the action of the antiseptics, it is claimed, have no injurious effect upon its tissue. The antiseptics preserve the hides from putrefaction while undergoing the above process, and it is claimed that by being to some extent incorporated into the tissue of the hides preserve them from putrefaction for a greater length of time after they have been softened—in case the hides do not go immediately into the lime—than any process heretofore known.

When the liquor has been mixed in the vat, as above described, the hides are immersed therein, and receive substantially the same treatment, as regards stirring, mixing, etc., that they would receive under the old processes, and remain therein until they are sufficiently softened. The time required for softening will vary in the same manner, though not to so great an extent as in the old processes, and will, the year round, require on an average, it is claimed, not more than one-half of the time required by the process now in general use.

Berry's Process for Softening Hides.

This process was patented by Berry, and is for softening dry hides intended for sole or upper leather, the ingredients being:—

Slaked lime	½ bu.
Wood ashes	½ bu.
Potash (dissolved in water)	12 lbs.
Oil of vitriol	5 lbs.
Spirits of salts	4 lbs.

These substances are placed in a vat of water capable of holding twenty-five dry sole leather hides, and after being well stirred the hides are placed in it and remain three or four days. They are next placed in a preparation for unhairing, composed of—

Slaked lime	1 bu.
Wood ashes	1 bu.
Potash (dissolved in water)	4 lbs.

From the last liquor they are drawn every other day until "raised," and when the hair begins to start they are split into sides and placed in "lime liquor," and handled every day until they are fit to "unhair," and from this point the treatment is as usual.

List of all Patents for Softening[1] *Hides, issued by the Government of the United States of America, from* 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	Feb. 4, 1833.	A. McMillen,	Bedford, N. H.
	Mar. 6, 1833.	Wm. Berry,	New Sharon, Me.
127,947	June 18, 1872.	J. Barron,	Cincinnati, O.
152,908	July 14, 1874.	J. D. Marshall,	Chicago, Ill.
234,248	Nov. 9, 1880.	Wm. Coupe,	South Attleborough, Mass.

Section III. Process for Plumping before Depilating, and the Treatment of Hides or Skins with an Acid Solution before Liming, for the Removal of Salt or other Matters.

Mr. Homer Ely, of Balston Spa, New York, has invented a process for "plumping" hides previous to depilating, and it consists in a method of softening and preparing the hides and skins as a preliminary to the action of the tannin liquor, and, though applicable to skins in either the fresh or salted state, it is claimed to be particularly applicable to hides and skins which have been previously salted.

In carrying out the process, place the hides or skins in a vat of clear water, allowing them to remain a sufficient time to soften and remove all the dirt or other foreign substances that may adhere to the surface, and also to soften the hitherto dry and hard hides or skins sufficiently to allow them to be divided down the back into halves, technically called "sides." The

[1] In addition see patents Nos. 59, 627, 136,081, and 226,447, described under the head of Depilating. See, also, list of Patents for Hide-Mills and Boarding Machines.

hides remain in this first vat for twenty-four hours, when they are sufficiently softened to be taken out and divided. When the dividing is performed, place the sides in a vat, preferably suspending them by hanging them over bars in a vertical position, twenty sides being a convenient number to operate with in a single vat. For this number of sides the inventor uses in the vat a solution of sulphuric acid in water, in the proportion of five pounds of commercial sulphuric acid in about twenty-one hundred gallons of water, which will cover the above-specified number of sides when properly placed in the vat. The action of this solution is to decompose all the salt remaining in the hides or skins. It also softens the gelatine, and opens the pores of the hides or skins, exerting that action upon them which is technically known as "plumping." The pores of the surface of the skin are opened in this way for the easy and rapid escape of any deleterious matter contained therein.

During the process of plumping, all earthy impurities previously adherent to the hide are thrown out of the pores of the skin, and deposited at the bottom of the vat in the form of a dark-colored-sediment, which is easily washed out of the vat by the aid of clear water. The hides are in this way, it is claimed, thoroughly soaked, plumped, and cleansed, and, at the same time, such portions of flesh as still remain adhering to the hide are softened, so that they are very easily removed.

In order to complete this second step in the process thoroughly, the hides or skins are subjected to the action of the sulphuric acid solution for from eighteen to twenty hours. The acid solution is then drawn off from the vat, and the hides or skins are rinsed thoroughly with clear water. Then remove the hides or skins, and place them in another vat containing about fifteen hundred gallons of water. Then dissolve in a sufficient quantity of water, to make the solution perfect, two pounds of sal-soda and five quarts of soft soap. After these materials are thoroughly dissolved, add the sal-soda and soap solution to the contents of the last-mentioned vat. The action of the soap upon the hides or skins is to neutralize the remaining acid in the pores thereof, a certain quantity of the soap being decomposed, and its alkali uniting with the acid to form a

soluble salt, which is soaked out in the water of the vat. A certain amount of oleine, margarine, or stearine, contained in the soap, remains in the texture of the hides or skins, together with a little glycerine. The action of the sal-soda is to keep the hides plump and pliable. When it is omitted from the solution they become shrunken and flat. It is best always to observe the precautions to have a slight excess of the soap and sal-soda over and above the amount necessary to neutralize the remaining acid in the hides or skins, and to allow the hides or skins to remain in the vat containing the soap and sal-soda solution for twenty-four hours, at the end of which time they are ready for liming.

In the liming the inventor prefers to adhere to the ordinary course employed by tanners, using nothing but lime. After the hides have passed through the lime, and the hair is removed, work them out of soft warm water, and then the inventor follows the usual course through the "bating." He allows them to remain in the bate three days, after which they are thoroughly milled, and then, in as rapid succession as possible, they are three times handled in or passed through a solution composed of about twelve hundred gallons of water and three pounds of sulphuric acid, the solution being maintained at a temperature of about 100° F. This treatment neutralizes any lime there may be remaining in the hide, and also removes the roughness that sometimes shows itself on the hair side of the hides or skins when the bate is not in a proper condition. If the hides or skins have not been sufficiently softened in the bating, all the remaining hardness will be removed, it is claimed, by the action of the last-mentioned solution. From this solution the hides or skins are passed into another vat containing about twelve hundred gallons of water to which two pounds of sal-soda and five quarts of soft soap, previously dissolved in soft water, are added. The hides are handled in or passed through this solution twice, and are allowed to remain two hours in the solution after handling. They are now ready for the final working or beaming previous to their treatment with the tanning liquor. After they have been thoroughly worked or beamed, they are thrown into a vat of

water maintained at a temperature of from 90° to 100° F., in which has been previously dissolved saltpetre, in the proportion of one ounce to about thirty gallons of water. In this vat they are allowed to remain for one hour. The action of the saltpetre on the hides or skins, it is claimed, is to "plump" or "raise" them, as it is called, facilitating the swelling of the gelatine in the tissue of the skin, and preparing the way for the free admission of the tannin.

The hides or skins are then ready for the action of the bark or tanning solution in which they are then placed. After having reached this stage in the process of converting skins into leather, the inventor follows in every particular the original process of tanning, by the use of barks containing tannic acid, using nothing but bark in the water of the vat, and discarding everything else of a chemical nature. By this process the inventor claims to be enabled to dispense with the operation known to tanners as "fleshing," and also to save at least one-fourth of the time employed in converting skins into leather by the usual method. By this process the inventor claims to also utilize for glue manufacturing or other purposes a large quantity of fleshy substance, which is usually thrown away, and also to decrease the expense of time and labor, and facilitate the process of handling, which is performed in a more satisfactory manner.

The advantage claimed to be obtained by plumping before liming is, that it opens the pores of the surface of the skin, so that the dirt and other deleterious matter which would otherwise obstruct subsequent processes escape freely, and settle to the bottom of the vat.

By this process the inventor claims also to obtain an improved quality in the leather, and that the hide acquires a greater degree of softness, pliability, toughness, strength, and weight than by any other process. These qualities, it is claimed, are obtained by preparing the hides so thoroughly for the reception of the tannin as to obviate the necessity of using other chemicals with the tannin, and yet to admit of the hides or skins being tanned perfectlyin a short space of time.

By supplementing the bating by the action of sulphuric acid,

the inventor claims to avoid any weakening or other injury of the leather by putrefactive action in the bate, which sometimes occurs when the bating is too long continued.

Although we have specified the proportions of acid and water in the above-named solution, and the proportions of sal-soda and soap to be used for a given amount of water, it is claimed that it is not necessary to be strictly confined to these proportions, but that the strength of all the solutions may be varied according to the condition of the hides or skins.

CHAPTER XIV.

HIDE-MILLS—LIST OF AMERICAN PATENTS FOR HIDE-MILLS—LIST OF AMERICAN PATENTS FOR BREAKING HIDES.

It is usual to soften dry hides and skins in the hide-mill after they come from the soaks and have been divided into "sides," and previous to subjecting them to the liming process, and the time which they are worked in this mill depends upon the hardness or softness of the hides or skins. For the sides that are intended to be worked for upper leather, the usual time is from one-quarter to three-quarters of an hour, while skins that are intended for the production of Morocco leather are usually worked from ten to twenty minutes.

The construction of hide-mills differs greatly for the various branches of leather manufacture. Those employed for softening hides and kips are similar to the fulling mills common in woolen factories; while the mills used for manipulating skins, such as goat and sheep skins intended for the production of Morocco leathers, are sometimes in the form of a large revolving drum the interior of which has a number of oak pins attached securely to it, and so arranged as to soften the skins as they fall upon them, or in other ways continually come in contact with the pins. The number of skins placed in a mill of this kind at one time is from one hundred and fifty to two

hundred, and the Morocco tanners at Lynn, Mass., and other places in New England where it is used, call it a "pin-mill."

The Morocco tanners of Philadelphia, Penna., employ, sometimes, a softening mill for the dry skins of a very different construction, which consists of a central, vertical, or upright shaft, on the top of which is keyed a beveled-wheel, which meshes with a suitable pinion. About two feet above the socket in which the upright shaft revolves, and passing through and secured firmly to the main shaft, is a second shaft about fourteen feet long, and extending horizontally at right angles with the upright shaft so as to divide itself into two arms of equal length. About one foot from the end of each of these arms there is an iron collar secured to the shaft, and against each of these collars a large granite roller, about four feet in diameter and eight inches face, is rested: the ends of the projecting arms of the horizontal shaft passing through the centre of the stone rollers, which are held in place by large iron washers which play loosely on the shaft against a steel pin.

A pit is excavated about three feet deep, following the circle described by the inside vertical face of the two stone rollers.

The socket in which the main or upright shaft revolves is placed on a level with the bottom of the stone rollers, and is supported upon a pedestal firmly planted in the centre of this circular pit.

A workman stands in this pit and arranges the skins under the rollers as they revolve, sometimes exposing the flesh side and at other times the hair side to the rollers, and all the while keeping them moistened by throwing water upon them, which he obtains from the bottom of the pit in which he is standing.

Mills of this kind may have their advantages for softening skins, or they would not be employed by some of the largest Morocco tanners in this country; but they are to my mind both clumsy and dangerous, as it is simply a question of time when one or both hands or arms of the workman who attends them will be crushed by the rapidly revolving stone rollers, and the skins are constantly exposed to injury by remaining too long in one position under the rollers.

The hide-mills in common use, such as that shown in Figs. 65 and 66, are lined with iron, and when properly constructed and cared for will wear for a long time.

The hide mill is not a new idea, but was patented in this country in 1812 by Wm. Edwards, of Northampton, Mass.

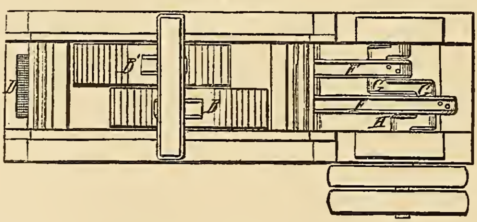
Mr. Edwards was also the inventor of the rolling contrivance now so commonly employed for rolling sole leather, both of which inventions have of course been greatly improved since his time.

The idea of the hide-mill is primarily due to the fulling machine, of which it is a reproduction with but slight modifications, and to trace out the origin of the fulling machine would carry us far back near to the early dawn of history.

A representation of the fulling process is shown on a tomb at Beni Hassan of about the time of Osirtasen, who is supposed to be the Pharaoh who invited Jacob to Egypt and settled him in Goshen. In this picture the roll of cloth is wetted and manipulated between a block and a concave inclined table, which table is very similar to the one-half of the trough of our hide-mills, and the water from the wetted cloth is represented as passing into a trough at the bottom of the table.

The hide-mill shown in Figs. 65 and 66 can be employed for softening all kinds of hides and skins; when used for cleansing

Fig. 65.



and softening sheep skins in the wool, the screen arrangement underneath can be used to save all the wool that becomes loosened.

Fig. 65 is a top view. Fig. 66 is a vertical section of the mill.

The hides or skins are treated by placing them in the reservoir A, of the mill, the beaters of which are represented at B B'.

The beaters have arms, E E, extending downward from them,

and being jointed to connecting-rods *F F*, applied to bell-cranks, *G G*, of a shaft *H*, which shaft imparts a reciprocatory vibrating motion to the beaters when it revolves. An improved method for connecting the pitman to the beaters is shown in

Fig. 66.

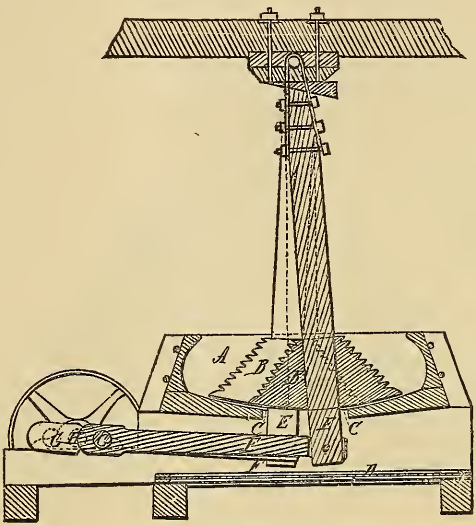


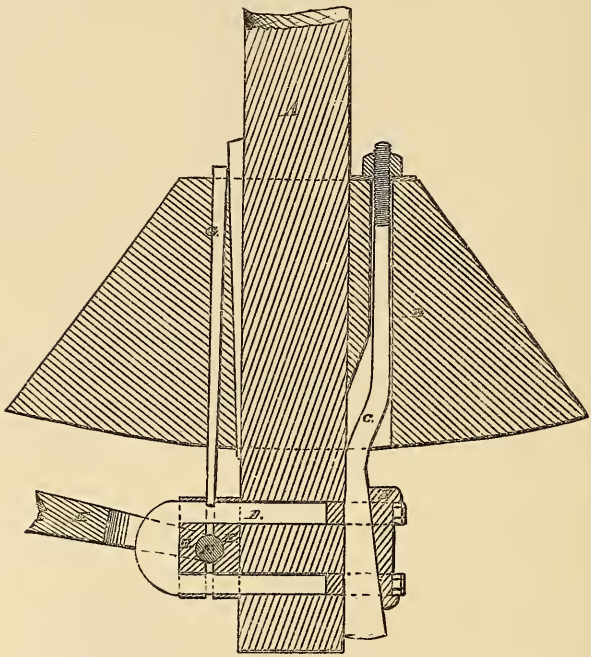
Fig. 67. After the reservoir or trough of the mill has been charged with the hides or skins, and the beaters set in motion, water is let into the trough. Whenever sheep-skins are being operated upon, there is placed, as has been mentioned, underneath the reservoir or trough, a frame, *D*, covered with woven wire, and as the wool is worked from the skins it is washed through the opening *C*, and lodges upon the screen, and in this way a large quantity of fine wool is saved.

The improvement in hide-mills, shown in Fig. 67, is the joint invention of Friend and Annable, and relates to the method of connecting the pitman, which actuates the beater of the mill, with the vibrating arm upon which the beater is hung (below the beater), in such a manner that the connection is made more perfectly than heretofore, and the parts may be tightened or adjusted from the top of the beater with less difficulty and

trouble than is the case with the usual method of adjusting the parts.

The invention consists, for this purpose, in making the connection of the pitman and vibrating arm by means of a strap, which passes through or around the vibrating arm, having a bearing for the end of the pitman on one side, and a gib and key on the

Fig. 67.



other side, the key passing up through the beater, and adjusted by means of a nut on the top of the beater; and in carrying an oil-tube from the working parts up through the beater, so that the connections may be lubricated.

The invention is designed to overcome the difficulties and imperfections of the common method of adjusting the parts before described in hide mills. As usually constructed and operated, it is very difficult to get at the connections for the purpose of taking up the wear which is the result of the continual jar and vibration.

It has been found from experience that it is essential to make this connection below the beater, and consequently, below the hide-box, and from this cause, whenever the connection wears loose, there are no adequate means for readily adjusting it, and no method of lubricating the wearing parts. The wear is thus much greater, and there is more danger of injury to the mill from this cause.

All the filth from the hides which are being milled passes down into the cavity below the hide-box, where these connections are located, making it a very disagreeable process to keep the connections in order, or to get at them for lubrication.

The present invention for making these connections avoids most of these difficulties by making the parts adjustable and capable of being lubricated from the top of the beater, and the result is that the mill operates more perfectly, with less wear and injury to the moving parts, and with greater economy.

Fig. 67 represents a vertical section of the beater, the lower part of the vibrating arm, and the parts employed in the new method of making the connection.

A represents the vibrating arm. *B* is the beater, which is attached to the vibrating arm in any suitable manner. *C* is a key, which passes through a slot in the strap *D*, up through the beater to the top, where it is adjusted by a nut. The lower part of the key *C* is wedge-shaped, to correspond with the shape of the gib *H*.

The strap *D* is made of iron, or other suitable material, and passes through the vibrating arm. It has a bearing, *E E*, on the side opposite the key *C*, for the purpose of holding the end of the pitman *F*. This bearing is made wider than the strap *D*, for the purpose of shouldering against the side of the vibrating arm.

G is an oil-tube, which passes down through the beater *B*, through the strap *D*, and into the bearing *E*.

When the pitman *F* becomes loose from wear or other causes, it is only necessary to tighten the nut on the top of the beater, which raises the key *C*, drawing the strap through the vibrating arm, and tightening the bearing *E E*, which incloses the end of the pitman.

The mill shown in Figs. 68 and 69 is for softening hides, and also for fulling cloth, and the invention consists in making the bed and back in two pieces, hinged or otherwise connected, and also in combining steam-chambers with the bed and back pieces, and furthermore in the form or shape of the back-piece, and in making it adjustable.

Fig. 68.

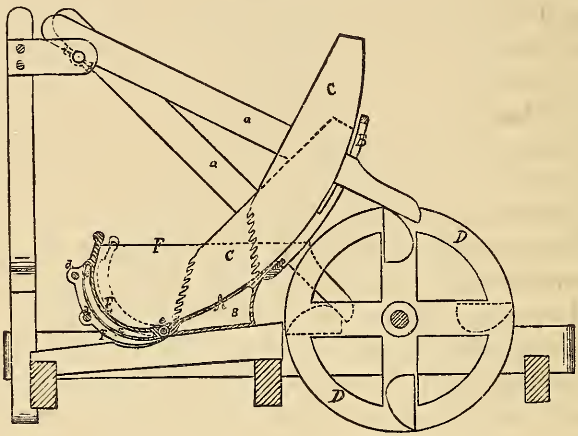


Fig. 69.

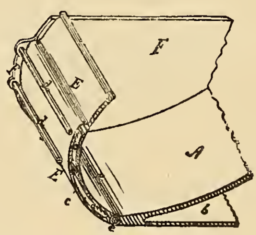


Fig. 68 is an elevation in cross-section. Fig. 69 is a perspective, partly in section, of the back and bottom pieces.

A is the bed piece; *B*, the curved slotted guides of the levers *a a* of the beaters *C C*. The slotted guides are provided with rubber packing or cushions to deaden the fall of the levers when there are not enough hides in the mill to receive the full

stroke of the beaters. D is the cam-wheel which operates the beaters. b represents a chamber, which is cast or formed in the bed piece, making part of the same, to which steam is to be introduced through suitable pipes. To the end of this bed piece is hinged or otherwise arranged a curved adjustable back, E, having also cast or formed in its back or rear a steam-chamber c, the object of both being to apply heat through the iron bed or back piece to assist the beaters in softening the hides. Making the bed and back pieces in two parts produces an important effect, viz., to permit of the adjustment of the back, which is accomplished by hinging it to the bed piece (shown at e), and by back bolts d d, which pass through the side pieces F of the frame, which hold the back at any angle desired. This adjustment allows the operator to turn the hides, by the action of the beaters, faster or slower, as they may require, and to turn hides of different grades as regularly and evenly as though they were all alike. Hard flint hides require, in order to be worked equally well, the back of the mill to be at a different pitch or angle than for soft hides. The shape or peculiar curve of this adjustable back E is also a very important feature of this invention, and it has been a work of great difficulty to arrive at the right form, so that the hides will gradually and regularly, by the action of the beaters, be turned over and over, so that each and every part of the hides will, in turn, receive the strokes. A slight change in the curve or shape of the back would result either in the contents of the mill not turning over at all, or, after turning a time, they would wedge fast in the bottom of the mill, which would necessitate stopping it and re-adjusting its contents. The peculiar form of this back piece E and its adjustment to the bed piece A cause the beaters to turn the contents of the mill completely over with a few or many strokes, at the option of the operator. It is claimed that this mill is self-acting, requiring neither tending nor watching. Its use for softening hides should be found very important, as they can be manipulated and softened, it is claimed, in a better and in a much shorter space of time than with ordinary mills. When used for this purpose, iron pins are inserted in the heads

of the beaters. This mill can be made entirely of metal, thus adding to its strength and durability.

The hide-mill shown in Figs. 70, 71, 72, and 73 is the invention of Middleton, and he claims that his improvements in machinery for stocking, unhairing, and softening hides, skins, and leather have the effect of rendering the machines capable of operating much more quickly upon the leather, hides, or skins, consequently doing a greater amount of work. The number of strokes or blows of the machine per minute upon the leather or hides may be varied, as also the strength or force of the blows.

Fig. 70 is a part longitudinal section, Fig. 71 a part transverse section, Fig. 72 a plan looking at the top, and Fig. 73 a front elevation of part of machine to be described hereafter.

Fig. 70.

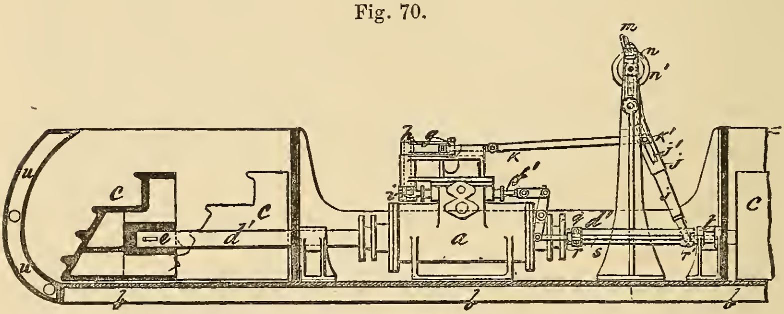
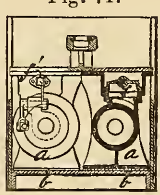


Fig. 71.



The inventor places two steam-cylinders *a a*, on a foundation-plate *b*, side by side, so as to act direct upon the stock-feet *c c*, which are coupled to the end of the piston-rods *d d′* by means of ordinary cotters *e*, as shown. Motion is imparted to the pistons, which are within the cylinders and of ordinary con-

struction, by steam, which is admitted thereto through ordinary slide-valves by means of a variable valve-motion, $f\,f'$ being the valve-spindles, each being actuated by means of a sliding cam g, through oscillating levers h and i. The required

Fig. 72.

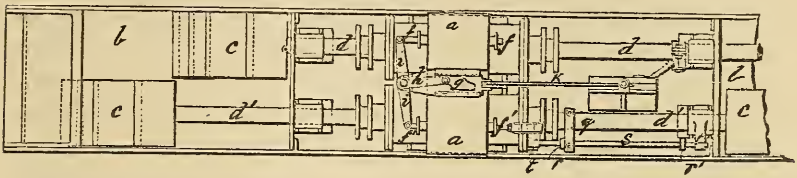
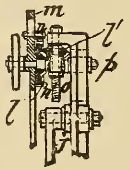


Fig. 73.



motion is transmitted to the cam from one of the piston-rods d, through lever j and connecting rod k. The motion of the cam g is varied by a self-acting ratchet arrangement.

Every stroke of the pistons carries the lever j with them, from which an intermittent motion is transmitted to the bevel-wheels l and l' through the rachet-lever m, pawl n, and rachet-wheel n', the bevel-wheel l being fitted with sliding key on to the screw o, on which, also, is provided the nut p. On a rotary movement being given to the screw o a traverse motion is imparted to the nut p, which carries with it the rachet-gearing, and lever m also varies the position of the end k' of the connecting-rod k in the slot j' of the lever j, which has the effect of varying the traverse of the cam g, and thence the motion of the slide-valves employed for admitting steam into the cylinders; also, by this motion the steam is exhausted at variable points of the piston's stroke. The object of this variable movement is to cause the stroke of the feet of the stocks to be more or less effective, consistent with the proper working of the leather, hides, or skins.

As well as the above automatic arrangement of varying the stroke, it may also be varied by the hand of the attendant.

In order to effect a regularity of stroke of both piston-rods *d* and *d′*, the inventor applies a provisional tappet-motion on the piston-rod *d′*. The position of the clamp or tappet *q* may be adjusted and fixed in any required position on the piston-rod *d′*, and in the event of the stroke of the piston-rod *d′* differing from that of the piston-rod *d*, the clamp or tappet *q* comes in contact with one of the collars *r* or *r′* on the rod *s*, which is mounted in suitable bearings *t*, causing it thereby to move either right or left, which movement is transmitted to the slide-valve spindle *f′*, causing thereby the valve to be moved and the stroke of the pistons to be reversed. This arrangement only comes into operation when any irregularity occurs, and has the effect of preserving the stroke of each piston the same.

The inventor also conducts the exhaust-steam into jacketed ends *u*, of the frame-work, suitable openings being provided for the admission and exit of the same, and the steam supplies an inexpensive artificial heat to the stocks for the purpose of quickening the process.

List of all Patents for Hide Mills, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	Dec. 30, 1812.	Wm. Edwards,	North Hampton, Mass.
66,294	July 2, 1867.	J. M. Brown,	Boston, Mass.
Reissue 2,727	Aug 3, 1867.		
100,519	Mar. 8, 1870.	J. P. Friend and B. R. Annable,	Peabody, Mass. Salem, Mass.
109,393	Nov. 22, 1870.	J. G. Curtis,	Emporium, Pa.
125,135	April 2, 1872.	S. Hussey,	Gowanda, N. Y.
221,246	Nov. 4, 1879.	R. Middleton,	Leeds, England.

List of all Patents for Breaking Hides, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	Dec. 22, 1826.	H. C. Clark,	Randolph Co., N. Y.
	Feb. 13, 1833.	B. Aylsworth,	Masonville, N. Y.
229	June 10, 1837.	E. Kendall,	Newton, Mass.
6,710	Sept. 11, 1849.	I. S. Heershey,	Hagerstown, Md.
7,281	Apr. 16, 1850.	C. Bauchman,	North Whitehall, Pa.
92,776	July 20, 1869.	O. W. Bean,	Farmington, Tex.
107,562	Sept. 20, 1870.	E. D. Taylor and Wm. Rude,	Hornelsville, N. Y.
199,415	Jan. 22, 1878.	Wm. Coupe,	South Attleborough, Mass.
202,414	Apr. 16, 1878.		
241,308	May 10, 1881.		

CHAPTER XV.

PROCESSES AND COMPOUNDS FOR DEPILATING HIDES AND SKINS—THE LIMING PROCESS—OTHER DEPILATORY COMPOUNDS AND PROCESSES—DEPILATING BY SWEATING—THE COLD SWEATING PROCESS—THE WARM SWEATING PROCESS—OBSOLETE METHODS OF DEPILATING—LIST OF AMERICAN PATENTS FOR COMPOUNDS FOR DEPILATING HIDES AND SKINS.

SECTION I. THE LIMING PROCESS.

DEPILATION or "unhairing" is the process of removing hair from hides and skins, and while there are many methods for accomplishing this result it is commonly achieved by placing them in a solution of lime until the hair bulb is loosened, thereby allowing the hair to be readily rubbed or scraped off.

The use of lime is often inconvenient and in many ways unsatisfactory, as owing to the energetic action which free lime exerts on animal tissues, a considerable portion of the gelatinous tissue of the hide is disintegrated and decomposed during the liming process, being removed from the hide in the form of soluble gelatine, or else so altered as to be rendered incapable of combining with tannin, thereby incurring a serious loss in

the weight of leather that should be produced, and in its quality, as the skins or hides treated by this process produce leathers less supple and more brittle than is desirable.

These objectionable results are more of a physical than of a chemical character; the principal modifications of the chemical constitution of the hide or skin treated by the lime process is the slight increase in the quantity of lime which it originally contained, and a decrease in the quantity of fatty matters due to the saponification caused by the lime; the harshness and brittleness imparted to the leather being caused not only by the saponification of the fatty matters, but much more so through the presence of the quantity of lime which penetrates into the tissues.

Suppleness being an indispensable requisite for upper, Morocco, and other kinds of leathers, it is restored to them after being treated by the lime process by subjecting them to the action of a bating process, performed by immersing the hides or skins in a solution of hen, pigeon, or dog manure, and various other solutions which will be enumerated in Chapter XVII., the object of such treatment being to neutralize the lime contained in the tissues.

This "bating" is usually performed in consequence of the employment of lime for depilating, and as both of these processes are expensive and add largely to the cost of producing all classes of pliable leathers, it is much to be desired that some substitute for lime should be found which would be generally acceptable to tanners, and obviate the bating process as well as lessen the expense of unhairing hides and skins.

From the large amount of attention that is being given to the subject of depilating, both in this country and in Europe, and from the tendency of the age to cheapen all the manufactured products of general consumption, we are probably safe in saying that the time is now near at hand when the slow, inconvenient process of depilating by lime must be succeeded by more effective, rapid, and economical methods.

Some of the inconveniences of the liming process we recapitulate as follows:—

1st. The contact of caustic lime alters more or less the tex-

ture of the hide, and permitting it to penetrate the pores, it remains in them in the state of caustic lime, carbonate, or lime soap.

2d. The rinsings in water, bating, and the workings remove it only partially, leaving an impediment to thorough tanning.

3d. It also hinders the ready penetration of the tan liquor, and the perfect combination of tannin with the skin, and so obstinately resists removal during all manipulations that a portion is always found in the best leather.

These disadvantages have already led to numerous efforts for the substitution of other agents, which we will enumerate later in this chapter.

The present process to which hides are subjected is termed "raising," and by it the pores are distended, the fibres swollen, and the hair loosened. These results are effected by means of alkaline or acid solutions, and by sweating or fermentation. Milk of lime, as we have stated, is the alkaline liquor generally employed. Lime-water has been proposed as a substitute, but it is less permanent in its action, and requires frequent renewal in order to insure the perfect cleansing of the hides.

The primitive manner of removing the hair was to shave it off, but lime was employed even by the early Egyptians. The depilating process in addition to swelling the hide, thereby loosening the hair and disposing it to yield readily to the depilatory operation, also facilitates, by opening the pores, the absorption of the tannin.

If there is a desire to tan quickly, and produce good and heavy leathers, it is highly important that the hides or skins should be properly prepared in the beam-house. As the after results depend largely upon the intelligent care bestowed here, much more attention should in practice be given than most tanners are inclined to grant.

All hides that are intended for limed stock should be put in the right condition for the lime—that is, soft enough, but not flaccid—as dried skins may be greatly injured by being softened too much. A hide fresh from the animal is the best criterion as to the condition, for in that state it is best suited for the lime.

When placed in the lime they should be frequently handled or agitated, and should remain in the solution no longer than may be necessary to loosen the hair in order that it may be readily removed.

The ancients and those whom progress has failed to reach said, and say still, who limes, tans! Any tanner who entertains such ideas tans his stock without a thought of the difficulties he is creating for the currier.

Lime is a factor, useful and hurtful at the same time, and it therefore becomes necessary that the tanner should occupy himself actively with the conduct and the good management of his lime-pits, and he should in case of necessity entrust this work only to a reliable man, a good workman.

Most tanners neglect their work at the lime-pits; and when our American calf-skin tanners fully realize this point and shall take care of their lime-pits, and see to the intelligent beamwork of their stock, they will produce calf-skins of the first quality, for we possess better bark for this work than can be found in Normandy or any portion of France.

We shall diverge for a moment and speak of the proper treatment of calf-skins in the limes. When the slaughtered calf-skins peel they should be immediately taken out of the lime. After having allowed them to drip well, put them in a vat with enough water to cover them without floating. They thus undergo a first disgorging; they may, if necessary, remain in this water for eight or ten days without spoiling. This method is preferable to piling, for while in the water the skins disgorge and the action of the lime is weakened, and in the pile the lime continues its action, and if workmen in piling are not careful to open them evenly; the skins get what the curriers call "lime folds," which are almost impossible to eradicate in currying. But best of all, as soon as the skins peel, take them out of the lime-pits, rinse them and unhair them at once, as promptness in the execution of labor is an economy of capital. From this first stage the work must go on as fast as possible.

Salted calf-skins after being properly soaked should be put into the dead lime-pit, and afterwards treated the same as slaughtered stock from this point; but the dry skins require a

milder lime-liquor than the salted skins and the fresh slaughtered stock. This work is thus rendered a little slower on account of the lime-liquor in the dead lime-pit having been previously carefully weakened.

Lime in depilating has been at times replaced by acid liquors; but their employment requires the exercise of judgment. The dilute mineral acids make the hair yield easily; but at the same time they swell and soften the hide too much, so that the use of organic acids is preferable. In some tanneries lime is replaced by a mixture of slacked lime and ashes. Through the mutual action of the lime and the carbonate of potassium a caustic alkali is formed, which operates more energetically.

Lime-vats are constructed either of timber or of masonry, and in tanneries where hides are worked they are sunk into the ground so that the tops of the vats are on a level with the floor of the beam-house; but in goat and sheep-skin tanneries the vats are partly below and partly above the level of the floor, as shown in the view of vats in Figs. 236 and 263.

The vats destined to swell the hides to facilitate the depilation and raising are usually constructed so as to take sides instead of whole hides, the hides being usually split after soaking, which answers for upper leather; but it is very much better for the stock that is intended for sole, belt, and harness leather to lime the whole hides and then to split them into sides after liming.

When split previous to liming the thin portions of the hide, shoulders, etc., contract to a much greater degree than the butts and other thicker portions, and consequently the back line is irregular, which would not be so noticeable if the lime had uniform action on the whole hide, thus economizing the waste in cutting harness leather, but more especially belt-leather, where straight back lines are very desirable.

The number of hides determines ordinarily the quantity ot lime necessary for each vat. To make a new vat throw into it unslacked lump lime, cover with water gradually so as not to drown it, and stir well with a "stirrer" until slacked and reduced to the consistence of milk. This operation completed, leave it until it is ready to receive the hides. Sometimes the lime is prepared in a hogshead, and from this poured into the vat, care

being observed to retain the sediment in the bottom of the hogshead, which keeps the lime vats cleaner and is beneficial in many respects. The vats are distinguished as dead, weak, and live vats, and sometimes as old and fresh limes. The dead or old vat is that which has been frequently used and which has been nearly exhausted of its strength, the weak is that which has been used long enough to deprive it of a portion of its force, and the live or fresh vat is that which has not yet been worked.

It is easy to understand that the live vat becomes successively the weak and the dead vat. When a tanner uses more than three vats he establishes between the dead and live vats as many middling terms vats as convenient and the whole of the vats are called the raising series.

The raising should be commenced in the dead vat, and continue in consecutive order through the series to the live vat. In some tanneries in Europe the series consists of twelve or more vats; and in that case there should be a graduation in the strength of the liquors. The duration of this operation varies in different localities, as in all portions of Europe the hides are limed for a longer period than with us.

The practice is still in vogue among some tanners of using old limes which are charged with the decomposing matter extracted from previous packs, which practice, in warm weather, becomes extremely hazardous.

The time usually employed for liming different classes of hides and skins will be mentioned in the chapters devoted to the manufacture of sole, upper, calf, Morocco, and other leathers.

The reel is now generally employed for handling in the lime-vats and it is the most economical, convenient, and effective method, the sides being strung together, and passed over the reel from vat to vat.

Steinmann's apparatus for handling hides in the lime-pits is shown in Figs. 74 to 77.

Fig. 74 represents a pit furnished with this contrivance. Fig. 75 is a vertical section in the plane of one of the spikes.

Fig. 74.

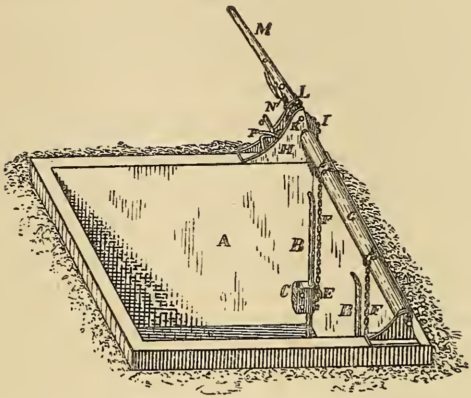


Fig. 75.

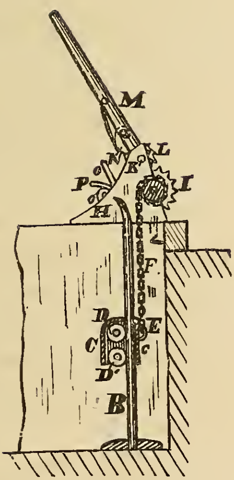


Fig. 76.

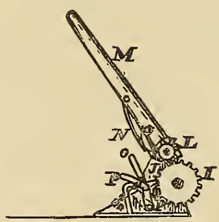


Fig. 77.

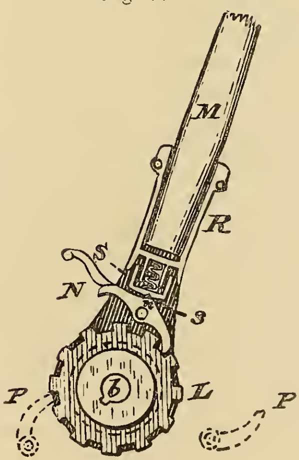


Fig. 76 is a vertical section of the operating jack or gear-work. Fig. 77 represents, on a larger scale, a form of lever, pawl, and ratchet movement adapted for use with such apparatus, one inclosing-plate being removed.

The pit *A* may be of any suitable form, from the bottom of which there rise two spikes, *B B*, with the points curved somewhat toward the interior of the pit, which makes it much easier for them to engage and disengage the hides than if they were straight, and besides the hides are in much less danger of injury. In other contrivances of a similar character blocks are sometimes used, having a roller on each side of the spike, and it has been found, in practice, that blocks thus constructed are liable to bind and hitch in the operation of hoisting the hides. It has also been found that portions of hide and hair would lodge in the unprotected rollers, and clog them to such an extent as to render the device nearly inoperative. But Mr. Steinmann claims to remedy both these defects by constructing the frame of the block in the form of a tube or sleeve *C*, half of which, *c*, is semi-cylindrical, and closely hugs one side of the spike, while the other half is made of proper form and dimensions to contain two rollers, *D D′*, journaled, one vertically over the other.

Extending from the upper part of each sleeve or block is an eye, *E*, for engagement of the hook on the extremity of a chain *F*, attached to a windlass, operated by a lever and ratchet and gear movement.

A suitable step or bearing, *H*, affords journal-bearing for the windlass-shaft, which shaft carries a spur-wheel, *I*, that gears with a pinion, *J*, on the ratchet-shaft *K*, to which shaft is permanently fastened a ratchet-wheel, *L*. A lever, *M*, having a pawl, *N*, engages in this wheel. A tentative pawl, *P*, pressed by a spring, *O*, prevents any retrograde rotation of the spur-wheel *I*, and thereby enables the windlass to hold the hides to the degree of elevation desired, or, being released, permits the parts to "run down," and the hides to descend by their weight to the bottom of the pit. The length of the lever and the excess of diameter of the spur-wheel *I* over the pinion *J* impart so high a purchase that one man can do the work of two or

more under the plan of previous contrivances of a similar character.

Fig. 77 shows the preferred form of operating lever, pawl, and ratchet; *L* represents the ratchet-wheel, having a central orifice, *b*, whereby it is fitted and keyed fast to the shaft of the windlass-cylinder. *R* is the lever-socket, sleeved, and capable of revolving upon a boss of said wheel. (Shown by dotted line.) *N* is a pawl, held to the position shown, or to the reverse position, or to one just intermediate, by spring-follower *S*. If it is desired that the lever *M* should feed in the opposite direction, the pawl is reversed, and the tentative pawl *P* is applied on the other side. If it is desired that the lever should be inoperative, so as to allow the hides to descend freely into the pit, the pawl *N* is placed so that its apex *n* will engage with the notch *s* of the follower.

In some tanneries in the West an apparatus is employed for liming hides which was invented in 1865, by Mr. Wm. H. Study, of Economy, Ind.; the contrivance consists of a rotary rack, so applied to a shaft as to adjust the distance and adapt the racks to hides of various sizes.

The frame used in conjunction with the rack is so arranged as to be readily raised or lowered, and the bottom of the liming vat in which the racks revolve is concave.

Section II. Other Depilatory Compounds and Processes.

Robinson's Process.

This process consists in loosening the hair or wool from hides or skins by the direct application of steam thereto while suspended in any suitable apartment to which steam can be admitted.

Ward's Process.

This method consists in the application of a compound solution of carbonate and sulphate of soda.

Wilson's Process.

In this method the depilatory compound is composed of 3 gallons of lime, 2 ounces of potassium, 2 quarts of strong soft soap, 2 ounces of ammonia, and 3 ounces of sulphur to each 100 gallons of water.

This composition it is claimed will start the hair in two days.

Carter and Keith's Process.

This is a solution composed of one barrel (33 gallons) of water, in which are dissolved sal-soda, carbonate of potash or common lye 11 pounds; prussiate of potash or nitrate of soda, 11 ounces; common salt, 11 ounces; lime, 22 pounds.

De Montoison's Process.

This process consists in subjecting the skins to the influence of a solution consisting of hydrate of lime, sulphide of barium, sulphide of arsenic, potash and hydrosulphate of soda, or other form of alkali.

Head's Process.

In this method the hides are placed in a vat about 8 feet long, 4 feet wide, and 4 feet deep, containing water into which has been poured a mixture of about one and one-half bushels of sal-soda, and one bushel of quicklime, which composition it is claimed will shorten the time for liming the hides to about six hours. They are afterwards soaked in a vat of water at a temperature of about 110° F. for two hours and then unhaired and lime-shaved.

Depilating with Steam in a tight Room or Vat.

The following method of depilating was invented by Banks. After the hides are softened in the usual way they are suspended in a tight room or vat, and subjected to the action of steam at a temperature not exceeding blood heat. This process is to be continued in warm weather about four days and in cold

weather about seven days, when it is claimed the hair can be easily and readily removed.

The inventor states that this method of unhairing is to be applied only to those hides that are to be manufactured into sole leather.

Depilating by the use of Soda-ash, Caustic Lime, Monosulphuret of Potassium, Hard Soap, and Soft Water.

For depilating a pack of fifty sides of cow hides, or one hundred and thirty calf skins:—

Take fifteen pounds of soda-ash, thirty pounds of caustic lime, stir them in ten gallons of soft water, and boil the mixture in an iron or other suitable vessel for one hour; let the solution become cold and then add one pound of sulphuret of potassium dissolved in water, and stir the whole thoroughly.

The next thing required is a vat of suitable capacity to receive the pack of hides or skins, with a sufficient quantity of soft water to cover them.

Into this vat of water a small quantity of the preparation before described should be poured, and the vat well stirred.

If the attendant by dipping his finger into the vat and applying it to his tongue does not feel a sensation and taste peculiar to the alkali, more of the solution must be added until the strength of the liquor is sufficient to produce these sensations.

Two or three pounds of hard soap may now be dissolved in water, added to the liquor and well stirred, which completes the preparation of the vat, and the hides or skins are to be placed in it, and agitated frequently in order to expose every part of them thoroughly to contact with the liquor.

Mr. A. K. Eaton, of New York City, who invented and used this process for a long period, states that in order that the hides or skins may not be too much plumped for the first twenty-four hours, the strength of the liquor up to the end of that period should not be increased; but after that it may be gradually strengthened as the process advances, and until it is completed, which will be in from two to four days according to circumstances, when the hair will come off very readily. By increas-

ing the proportion of the sulphuret of potassium, the time required for the process will be correspondingly shortened.

The labor involved in this process is comparatively slight, the stock, it is claimed, is in a better condition for being treated with the tanning agents, and it is also claimed that it is heavier than when the ordinary depilating process is employed, as less gelatine is dissolved. The leather when finished, it is also claimed, is closer grained, more flexible, as well as more durable, and less pervious to water when the skin is unhaired by this process than when unhaired by a process that dissolves more of the gelatine, as the texture is less open and the leather not so spongy.

The sulphuret of potassium, before mentioned, may be prepared as follows: Take equal parts by measure of finely pulverized charcoal and sulphate of potash, mix them thoroughly and expose them to a dull-red heat for an hour in a covered crucible, the product will be the sulphuret required.

Composition for Depilating Green and Dry Hides, with Nitrate of Potassa, Chloride of Sodium, Sulphuric Acid, and Tartaric Acid.

Hides may be depilated in an easy and expeditious manner and it is claimed without injury, and so as to produce a greater percentage in the weight of the leather than is possible by the ordinary means, by the use of the following composition: One-quarter of a pound nitrate of potassa, one quart chloride of sodium, four and a half pints sulphuric acid, one ounce tartaric acid, or, in lieu thereof, one pint of vinegar, twelve pounds of wheat-bran, and five hundred gallons of sour or spent tan-liquor. These ingredients are properly commingled and then applied to the depilation of dry or imported hides in the usual manner.

In treating green hides the first two ingredients, nitrate of potassa and chloride of sodium, and the wheat-bran, are omitted from the composition, their functions being solely to soften the hard, dry imported hides, and reduce them to a condition similar to the normal condition of the green hides. It is claimed by Mr. Peter G. Schlosser, of Middletown, Frederick Co., Md., who discovered this composition, and who proved it by a long

course of experiment and trial to be a very valuable one for the purpose above specified, that the injurious consequences resulting from the use of lime for that purpose are avoided, the substance of the hide itself not being eaten away and destroyed, as it oftentimes is when lime is employed. But all the body and strength are preserved, and a greater amount of leather is produced than it is possible to obtain when lime is used. Besides this it is also claimed that the time heretofore consumed in "bating" or cleansing the hide from the lime, which was very great, and the labor are entirely saved, and the whole process of preparing the material for tanning is in that degree shortened. Mr. Schlosser also claims that by this process twenty-five pounds of dry hide will produce about forty pounds of leather, and one hundred pounds of green hide will produce about seventy pounds of leather.

The employment of Sulphuretted Hydrogen Gas in connection with Lime, Soda-ash, etc., as a Depilatory, and for the purpose of Swelling Hides.

The object of this compound is to depilate and raise hides and skins preparatory to tanning, thus dispensing with milling and breaking.

In order to accomplish this the inventor, Mr. George W. Adler, of Philadelphia, Pa., uses a compound consisting of gas-lime, that is lime charged with sulphuretted hydrogen gas, which is the refuse lime of gas-works, an alkali, such as soda, potash, pearlash, or soda-ash, pure lime and an oil, and he also claims that this compound acts as a preservative as well as a depilating and raising agent.

The proportions are as follows: Of lime, pure unslacked or slacked, two bushels; of soda-ash, or any other alkali, fifty pounds; of oil, either vegetable, fish, animal or mineral, two and one-half gallons; and of gas-lime, or lime charged with sulphuretted hydrogen gas, two bushels, or enough to make a solution of the required strength as a depilatory.

In mixing or forming the compound, take the gas-lime and add sufficient water to make a solution, then take the two bushels of lime and slack, after which add the fifty pounds of

soda-ash, or other alkali, and dissolve it in water, or add the soda-ash or other alkali direct to the solution, now add the two and one-half gallons of oil, and mix the whole together, so that they will be thoroughly incorporated.

The compound is now ready for use, and is applied according to the judgment of those skilled in the art of treating or tanning hides and skins.

When the gas-lime is added to water sufficient to make a solution it makes a most powerful depilatory, but this is of no use, except as a depilatory, until the soda or alkali is added, as a raising agent for the purpose of swelling the hides or skins; the oil forms a basic or mineral soap in connection with the soda and lime, and it is claimed prevents the destructive action of the alkali upon the gelatine and tissues or fibres of the hides. Those who employ this method need not of course confine themselves to the exact proportions which have been given, as this is a matter of judgment; but the formula herein given has produced the best results in practice.

A Compound of Potash, Lime, Salt and Sulphur, and Charcoal for Depilating.

After the hides are prepared for depilation by soaking, milling, or breaking, in a proper manner, Mr. John Henry, of New York City, prepares and uses the following composition:—

Into four barrels of water put five pounds of potash, ten pounds of lime, ten pounds of salt, one pound of sulphur, and one-half pound of pulverized charcoal; having previously dissolved the other articles in blood-warm water.

The whole, which is sufficient for one hundred calf-skins, or an equivalent of hides, is then put into a revolving wheel, together with the skins or hides to be depilated, and the wheel is made to revolve at the rate of twenty revolutions per minute.

Mr. Henry claims that the skins or hides are, by the method above described, brought into direct contact, as to their whole surface, with the composition, and that, being agitated and kneaded, while in the composition, the process can be completed in ten hours.

He also claims that this composition is less injurious and

more speedy in its action, and enables the skin or hide to be tanned more rapidly afterward than if lime alone were used.

The Use of "Refuse Gas-Lime" as a Depilatory.

The bluish-green mass which is produced in the purification of illuminating gas, and which is considered a very obnoxious refuse by gas-makers, is generally known by the name of "refuse gas-lime." This substance, it is stated in the patent for the present process, consists of sulphide and sulphydrate of calcium, and small quantities of the lime salts of carbonic and subsulphurous acids.

The first two named ingredients, sulphide of calcium and sulphydrate of calcium, render this substance applicable for the purposes of depilation.

Mr. John E. Siebel, Chicago, Ill., the patentee of the application of this waste product for depilating, states that mixed with water this refuse forms a mixture which, on account of its containing sulphydrate of calcium, he used as a cheap and effective agent in tanning for freeing the hides from hair. For this purpose the refuse gas-lime, as soon as possible after it leaves the refining apparatus of the gas-works, is mixed with water to form a thick liquid, in which the hides are immersed until the hair is loosened, and ready for removal by the unhairing knife.[1]

[1] I fail to see on what grounds a patent could be issued for this process, as Boëttger had proposed the use of lime that had served for purifying gas, and the employment of this material for depilating purposes had been mentioned in technical books long previous to the date of this patent. See also Boëttger's process for depilating with hydrosulphate of lime, described on p. 288.

This material is a mixture of caustic lime, of carbonate, sulphite, hydrosulphite, sulphate of lime, of sulphuret of calcium, of hydrosulphuret, of sulphuret, and of cyanuret of calcium. The two last soluble salts especially act energetically on the hair bulb to dissolve it or to disunite it; besides the gas-lime may be replaced by an aqueous extract of such lime. In order to avoid the inconvenience caused by the liberation of prussic acid, it is best not, immediately after the peeling by means of gas-lime, to submit the hides to the action of acid liquids. A mixture of nine parts of lime and of one part of orpiment, which causes the formation of hydrosulphuret of calcium, may be used to peel the skins of small animals.

Depilating with the Double Sulphate of Sodium and Calcium.

This compound is the invention of Jules Watteau, of Antwerp, Belgium, and is intended to be used for facilitating the pulling of wool or hair from the skins of sheep or other animals. There are taken—

38.50 parts, by weight, of carbonate of soda,
38.50 parts of hydrated oxide of lime,
13.00 parts of flowers of sulphur,
6.50 parts of pulverized wood-charcoal,
3.50 parts soot.

These elements are pulverized and then intimately mixed together, and the mixture is boiled for about two hours, in a vessel containing about three times its weight of water, thereby producing a liquid of a dark-green color. This liquid, by means of a brush, is spread upon the fleshy side of the skin from which the wool or hair is to be removed. The skins are then placed in a pile, wool against wool, fleshy side against fleshy side, and after a few hours, it is claimed, that the wool can be pulled with the greatest facility without injury to the skin.

The soot and charcoal are not essential parts of this composition, but enter into it as inert matter, and so remain, as does also the carbonate of lime, which is one of the results of the combination above described. The liquid, it is claimed, derives its extraordinary depilating power from the resulting sulpho-sel or double sulphate of calcium and sodium.

The inventor gives the proportions of the carbonate of soda, hydrated oxide of lime, and flowers of sulphur, which, in practice, he finds to be best; but these proportions may vary considerably.

The patent of Brainard, dated May 20, 1862, No. 35,293; and the English patent of Claus, 1906, granted in 1855; and the application of Lynds, filed in the patent office in September, 1854, would appear to conflict with this invention, but the double sulphate of sodium and calcium is not obtained in any of the combinations and processes therein described. In one or more of them sulphide of sodium and sulphide of calcium are produced, but there is no chemical union between these two sulphides.

By boiling in water, however, as the inventor directs, there takes place, it is claimed, a chemical union not otherwise produced, or not produced to so great a degree in any other manner. By the boiling the two sulphides are chemically united at the instant of their formation, giving the double sulphide.

Depilating with Charcoal.

In lieu of lime for removing the hair and cleansing the pores, charcoal may be employed either as a substitute for lime, or the hides or skins may be, as heretofore, first partly treated with lime and finally treated with charcoal.

The carbonaceous matter employed may be either animal, vegetable, or mineral charcoal in suspension, and it is claimed by Mr. William Anderson, of Inverkeithing, near Edinburgh, Scotland, that the results of this treatment are that the hairs are loosened, the pores of the skins or hides purified, and the putrescent matter, grease, and other impurities removed.

Mr. Anderson states that the most advantageous method of carrying this invention into effect is as follows: The hides or skins are placed in water of 60° F. with powdered wood-charcoal sufficient to give it the consistence of cream, the hides or skins being removed and then placed back in the same liquor each day until the hairs are sufficiently loosened to yield easily; care being observed to stir the charcoal-powder which may have subsided in the intervals of removal, in order as far as possible to keep it in suspension.

The hides or skins are afterwards washed, fleshed, and scudded as in the ordinary method, when they are ready for tanning without other treatment, and the charcoal-powder may from time to time be revivified by drying it in thin layers in the sun or in a current of air.

In order to render them flat and soft, and to remove lime and other impurities from hides or skins, which may have been treated with lime for the purpose of removing the hairs, the process which has just been described may be applied.

Maynard's Method for Depilating by the employment of Lime in Water, together with Sulphurous Acid.

Liming hides, as we have seen, has been done by the use of lime simply, or lime and sulphur, potash, soda, arsenic, etc., alone or in combination, the time employed being of different durations. It is claimed by Maynard, the inventor of this process, that hides may be rendered fit for depilation by its use in a very short period of time, and at but small expense.

Maynard claims that the use of lime in water, together with sulphurous acid, causes the lime to seize hold of the oleaginous matter of the hide, producing a saponifying effect or giving a soapy feeling to the hide, and that by introducing sulphurous acid the sulphur and hydrogen attack the hair-bulbs, decomposing the sulphur contained in them, loosening and releasing the hair preparatory to depilation.[1]

The combination of Lye from Wood-Ashes, or Potash, and Lime which has been treated by the Gas generated by Sulphuric Acid, Sulphuret of Iron, and Water, for unhairing Hides and Skins and for pulling Wool.

The following process is the invention of Mower, and consists in a compound for "liming" and unhairing hides and skins, and for pulling wool; and consists of quicklime, lye from ashes or potash, sulphuric acid, and sulphuret of iron.

A compound is prepared in the following manner: Slack one pound of quicklime by the use of four quarts of water in a pail, to be as thick as good whitewash. Take a bottle that will hold one pint or more, clear white glass being the best. Have a half-inch lead pipe twelve to fifteen inches long, and fit one end air-tight in the mouth of the bottle. Bend this pipe so that the other end will enter the lime in the pail, one or two inches below the surface of the lime. Place four ounces of sulphuret of iron in the bottle, and cover the same well with water. Add sulphuric acid sufficient to cause the contents to boil. Then fasten the lead tube in the bottle, and let the other end into the

[1] Maynard's process for bating hides and skins, which can be employed in combination with this process or alone is described in Chapter XVII.

lime, as above stated. The sulphuric acid, when in contact with water and sulphuret of iron, will generate a gas, which is conveyed through the tube to the lime and colors the lime blue. The lime being an absorbent, the gas unites with the flour of lime. This operation should be performed in the open air, as it has a disagreeable odor. When the action in the bottle ceases and the contents become dry, add water and sulphuric acid, as at first; but should any water remain in the bottle after the action ceases, pour off the water and add water and sulphuric acid, as above, and continue the operation until the sulphuret of iron is all consumed. The lime is stirred occasionally, so as to mix the gas through the lime.

In order to test the strength of the thus prepared lime, if sufficiently charged with the gas, it will, if a small quantity be put on the arm, remove the hair, if any, in five or six minutes, causing no pain or doing no harm to the skin.

One gallon of the above-prepared lime will be sufficient to strengthen from five to six gallons of lime prepared after the common mode for liming hides.

The above proportions may be followed for preparing any quantity required.

To prepare large quantities of the prepared lime, for one barrel slack thirty-two pounds of quicklime by adding one gallon of hot water to each pound of lime.

As there is a difference in the quality of lime, the operator will have to use his judgment in preparing it to do the work intended.

Hides in this process of liming should be handled often ; or the best way is to have two limes prepared in adjoining vats and handle from one vat to the other once an hour for four to six hours, and occasionally after, as this process works rapidly, and by being handled often, will lime more uniformly.

For harness, upper, and calf-skins add lye sufficient to give a slippery feeling to the lime as follows: For a pack of one hundred and fifty sides of upper-leather, harness, or equivalent of calf-skins add lye from ashes or potash dissolved in water, from ten to fifteen gallons. Renew the lime by adding of the prepared lime from three to six gallons for every new pack to

be limed, which will keep the lime in good working condition. This process, as specified, will lime sole-leather hides in from ten to twenty-four hours, harness and upper-leather hides in from six to fifteen hours, calf-skins in from three to six hours. All depends on the strength of the lime and on being properly handled.

Sole-leather hides, when unhaired, are to be rinsed in cold water, when they are ready for the tanning process. Harness and upper leather and skins, when unhaired, are to be immersed in clear water and worked on the flesh side. When worked they are to be put in a vat of clean warm water and allowed to remain therein for a short time, and then the grain side worked, when they will be ready for the tanning process.

To pull wool, spread the flesh side up and apply a thin coating of the prepared lime with a brush. In about one hour the wool will come off easily, after which the skin is immersed in water the same as calf-skins and both sides worked, ready for the tanning process.

In the old method of liming the hides become so impregnated with lime that much bathing and labor are required to reduce them sufficiently to make good leather; but in this process it is claimed that the hides raise rapidly and remain soft without this bathing and excessive labor.

Lime, though an insoluble ingredient, cannot be dispensed with, as it is an absorbent, uniting with the gas generated by the action of the sulphuric acid, sulphuret of iron, and water. Lye, being a soluble alkali, penetrates, cleanses, and softens, in connection with lime in removing the hair, and will readily wash out with water. Sulphur is very penetrating and softening. Iron is important in connection with sulphur in making sulphuret of iron and making gas. Sulphuric acid in this process is an important ingredient in preparing hides for tanning and in connection with the sulphuret of iron and making gas. The above ingredients prepared as specified simply dissolve the roots of the hair, and the hide retains its weight and strength.

This preparation it is claimed is especially adapted for dry hides, as the ingredients, except lime, have softening qualities, which overpower the lime and raise and plump the hides, so that they will be and remain soft and pliable.

By this preparation it is claimed that the cost of preparing hides for tanning is materially reduced, and considerable time and labor are saved; and the tanning process will, if the hides have been previously prepared by this process, take one-third less time, and will produce leather of better weight, color, and quality.

Depilating and removing Grease with a compound of Water, Lime, Soda-Ash, Saltpetre, and Flowers of Sulphur.

The ingredients of this compound, and the proportions in which they are to be mixed for the purposes indicated, are as follows: Pure water, five hundred gallons; unslacked lime, one barrel; soda-ash, one hundred pounds; saltpetre twenty pounds; flowers of sulphur, ten pounds.

The above quantity is for treating one hundred ox-hides (or two hundred sides), and the following is the manner in which the compound is to be prepared, used, and applied for the purposes indicated: Clean the hides by water of all salt and impurities, allowing green hides to soak one day and dry hides eight days, or thereabout. Then take of pure water, five hundred gallons; of unslacked lime, one barrel; of soda-ash, one hundred pounds; of saltpetre twenty pounds, and of flowers of sulphur, ten pounds. Mix all of the ingredients well together until they are thoroughly dissolved. Then place the hides, so cleaned, in the solution and allow them to remain in it forty-eight hours. Then remove the hides and unhair them in the usual way.

By the above process it is claimed by Tinnerholm, the inventor, that the hair is speedily and thoroughly loosened, and the hides, while retaining the portion of their substance which can be tanned into leather, are, at the same time, cleaned from grease and other substances which prevent them from tanning quickly.

The above procees and solution it is claimed may be used and applied in the process and art of tanning or curing all kinds of hides and skins, care being taken to regulate the time in which they are kept in the solution, according to their thickness and the class of skins to be tanned.

The composition can be used and applied by any person of ordinary skill as a tanner.

Softening, Plumping, and Depilating Hides and Skins through the employment of Sulphide of Barium in solution.

Foley invented the following process for treating hides and skins previous to tanning, and it relates to removing the hair and epidermis from hides and skins of every description and however cured, softening dried and cured hides and skins, and separating the wool and hair from skins in their natural state.

For unhairing he uses, instead of lime, but in a somewhat similar manner, solutions of sulphide of barium of varying strengths, prepared by dissolving in water solid sulphide of barium, produced by heating finely-ground sulphate of baryta mixed with carbonaceous substances to about a white heat in a reverberatory furnace or other suitable appliance.

In treating green slaughter hides and skins to remove the hair and epidermis, first wash them to remove the blood and dirt, and then immerse them in a strong solution of sulphide of barium, about 15° Baume, for about three to six hours. They are then withdrawn, again washed, and taken to the beam-house, to be treated in the usual manner.

In the treatment of salted or cured hides and skins for the removal of the hair and epidermis, first immerse them about ten to twelve hours in an old or partially-spent solution of sulphide of barium, for the purpose of cleansing them and destroying the effect of the salt or substance with which they were cured; and afterward immerse them in a solution of sulphide of barium of about 6° to 8° Baume for about ten hours, when they are ready for the usual treatment in the beam-house.

In the treatment of dried or flint hides and skins, it is necessary, before the hair and epidermis can be removed, to soften them, and this do by soaking them about twenty-four hours in a solution of sulphide of barium that has already been used for unhairing, or in a weak fresh solution of about 3° Baume.

After the dried hides and skins are thoroughly softened in all their parts, in the manner above set forth, immerse them,

for the purpose of removing the hair and epidermis, in a solution of sulphide of barium of about 5° Baume for about six hours, and then pass them on to the beam-house.

In the treatment of skins for the removal of wool and hair, apply on the flesh side of the skins, by any suitable means, a concentrated solution of sulphide of barium mixed with any inert substance to the consistency of a thin paste. The solution applied in this manner penetrates the skin, loosens the roots of the wool or hair, and allows it to be removed uninjured and in its natural condition.

This invention has advantages over the liming process now in use for removing hair from hides and skins and softening them, and among others the following are claimed by the inventor: No part of the gelatinous tissue, grain, or substance of the hide is removed or disturbed; hides and skins are left in their natural state and suppleness; at least twenty-five per cent. greater weight of leather can be obtained from hides treated by this invention than by the old process of liming. The hair, it is claimed, is removed in one-twentieth part of the time usually employed, thus effecting a great saving in time, labor, and expense. Hides and skins treated by this invention and intended for upper-leather do not require to go through the operation of "bating," which effects another saving in time and expense.[1]

[1] A number of patents have been obtained for sulphide or sulphuret of calcium for the purpose of depilating hides and skins. Sulphide of calcium has been tried by tanners, both in Europe and America, and sometimes abandoned, owing to its cost, the increased expenditure for labor attending its application, and its supposed injurious action upon the hides. It is claimed against it that it dissolves and removes a portion of the fibrous tissue, a very formidable objection to its use, if true.

In my observations, I have found that sulphur combined with lime simply renders the lime more soluble, allowing it (the lime) to act more quickly; but in this state the lime also penetrates the hide, and, notwithstanding repeated washings, remains in the hide and forms with the tannin an almost insoluble tannate, which deprives the hides of their suppleness and renders them dry and brittle.

Depilating with a compound of Water, Burnt Oolite, and Muriatic Acid.

In describing this compound and its use, the inventor, Tinnerholm, has based it on an estimate of one hundred pounds of skins or hides to be treated.

One-eighth of a bushel of lime is dissolved in water and the lime solution poured into a vat containing sufficient water to cover the hides. Next a suitable quantity of burnt oolite (or other limestone of a like nature—*i. e.*, pure calcareous spar) is treated with two ounces of muriatic acid, after which a proper quantity of water is added to form a strong lye, when this solution is also poured into the vat and the whole is thoroughly stirred. The skins or hides are now deposited in the liquor and allowed to remain therein three days. They are then taken out and the hair scraped off, after which they are placed in a vat containing fresh water and left to remain one day. They are then removed, the flesh and lime still adhering is scraped off, and they are in condition for the bating process, which follows the liming in the manufacture of certain classes of leather.

Depilating with a Mixture of Water, Lime, and Blood.

The preferred manner of carrying out this plan as stated by the inventor Bollman, is as follows: The hides or skins are first soaked in water to remove the blood and like adhering matter, after which they are drained off. They are then placed in a vat containing water, lime, and blood in about the proportions of one bushel of lime and one and a half gallons of blood to fifteen barrels of water for the first supply or charging of the vat. As the water, lime, and blood are absorbed, to a greater or less extent, it becomes necessary or desirable to replenish them after each stock of hides is removed, or, in other words, to maintain about the relative proportions stated.

It will be understood that the proportions of the ingredients may be considerably varied; but the formula given is preferred, being found, it is claimed, in practice to give excellent results.

In some cases the first washing may be dispensed with and the skins placed at once in the lime-vat, in which case, the

skins already containing a considerable quantity of blood, the amount separately added to the water of the lime-vat may be materially lessened. While as far as it goes the inventor considers this plan the equivalent of the first, and as included within the limits of his invention, he does not deem it the full equivalent of the first-described method, because he finds by actual experience that it does not produce as fine a quality of leather. He also claims to have found in practice that hides or skins treated in this way require a much less prolonged soaking in the tan-bark solution than hides treated in the old way, the difference in time being as one and three, and from that to one and ten.

Leather prepared in accordance with this method is soft and pliable, yet tough and firm, and, it is claimed, will not become rough with use or wear, and will shed or exclude water far more perfectly than leather prepared by other plans. Again, he claims that he is enabled to accomplish the tanning operation with a far less quantity of bark than is required by other plans, from one-half to one-quarter the usual quantity being sufficient.

It is claimed that the presence of the blood causes the hide to come from the lime-vat soft and flexible, without being worked, handled, or treated in any other way than mentioned. Besides decreasing the expense by reducing the required quantity of bark and shortening the necessary period of immersion in the bark solution, thus permitting other hides to be immersed therein, and also saving a great amount of labor formerly required in handling the hides in the lime and bark-liquor vats.

A bating mixture has been proposed, in which blood and ammonia were to be used (with or without sawdust and urine) with water; and it has been proposed to apply blood "at its stage of separation from the *serum*" to skins or hides, and therefore Bollman does not claim broadly the use of blood. The invention differs from the first of these plans in that, instead of being a bating solution, it is a depilating mixture designed to render a bating solution unnecessary, by leaving the hides in a soft, pliable, and desirable condition, and, it is claimed, ready to be placed in the tan-vat. It differs from the second plan in

that, it is claimed, that by the use of lime the depilating action is materially hastened, while the presence of blood prevents the injurious effects which would otherwise be occasioned by the employment of lime.

Depilating with Water, in an open Vessel.

This invention relates to the employment of a process for unhairing skins of all kinds such as those of sheep, lambs, goats, rabbits, hares, calves, oxen, cows, etc., by means of a water-stove, in which the skins are vertically suspended.

The means employed are the following: Make a water-stove instead of a fermenting-stove, but with this difference, that instead of having a hermetically-closed chamber simply establish a large or small basin or pan capable of being left uncovered. Arrange hooks exactly the same as in a fermenting-stove, and hang the skins thereon by the shanks, side by side, taking care to keep them perpendicular. The skins being hung up and descending nearly to the bottom of the basin or pan, fill up the latter until all the skins are entirely submerged. The water naturally causes the peeling, and when this peeling takes place the skin has not suffered at all in the water. On the contrary, it has gained in value and the wool is completely preserved. When the moment for peeling has arrived, it is only necessary to empty the basin or vat, the skins drain separately, and they can be peeled easily. By this water system it is claimed by Mr. Aime Laure, of Mazamet (Tarn), France, the inventor, that he is also enabled, while preserving the leather and the wool, to accelerate more or less the operation of peeling. If it is preferred to let the skins follow their natural course, cold water may be used both in winter and summer. It will be understood that the skins take longer to peel in winter than in summer; but no harm is occasioned by that. If, on the contrary, it is desired to accelerate the operation of peeling, use tepid or hot water, and add to the bath any material capable of hastening this operation—such as soap, soda crystals, strained bran-water, etc.,—provided, always, that the materials employed are not such as would injure either the leather or the wool.

It may be observed that, if care has been taken to put the

skins into the water-stove perfectly scoured and washed (by means of what is known as the "Puech Process," for example), wool can be obtained of a value hitherto unknown.

By this process of peeling, it is claimed by the inventor that the leather obtained is not only worth more, but it can be manipulated immediately, or the skin may be salted, and, more especially, it may be dried without losing any of its quality.

As will have been seen in the foregoing description, the inventor has tried to replace violent and dangerous means by a most natural, practical, and economical method.

He does not claim laying hides or skins one upon another in a bath. This has been done before, and is objectionable, because the skins lying one on top of the other prevent free action of the bath on their surfaces. In fact, the uppermost skin will be finished on its upper surface before any appreciable effect has been made on any of the other surfaces, and will mislead the attendant into the belief that the lower skins are in the same condition as the upper. Again, the pressure of the pile of skins is liable to injure the lower skins. Finally, the skins, when placed one upon another in a bath, cannot be drained without being first rehandled, while by this process, when the water is let out, they drain without being disturbed.

Depilation by Sulphuret of Calcium and Soda.

Boudet, in trying the old method of depilating by means of a paste of orpiment and caustic lime, observed that the arsenic had no decided influence upon the hair, and that the depilatory action was due to sulphuret of calcium in the nascent state, formed by the reaction of lime upon the orpiment (sulphuret of arsenic). He replaced the orpiment by sulphuret of calcium, which, when made into a paste with lime, acted so promptly that, after twenty-four or thirty-six hours' contact, the skins were completely depilated. The lime alone has no depilating effect, and the sulphuret of sodium only a partial action.

Tanners are opposed to this method, which, it is said, surcharges the leather with an amount of water that escapes by evaporation during storing, to the great loss of the dealer, but we do not think that this objection is tenable.

Potash, Lime, and Orpiment as a Depilatory.

Macerate the hides for three days, put them in the vat, raise three times, and then for each skin put—

Potash	$2\frac{1}{2}$ drms.
Lime	5 oz.
Orpiment	$\frac{1}{2}$ oz.

This quantity is sufficient for three small goat or sheep-skins. For twenty-five hides take—

Potash	1 lb.
Lime	2 lbs.
Orpiment	2 oz.

The whole is dissolved in fifty gallons of water.

This vat is much less commended than the preceding, and is liable to numerous objections, and the principal is the danger to health accompanying its manipulation.

Depilation by the Hydrosulphate of Lime.

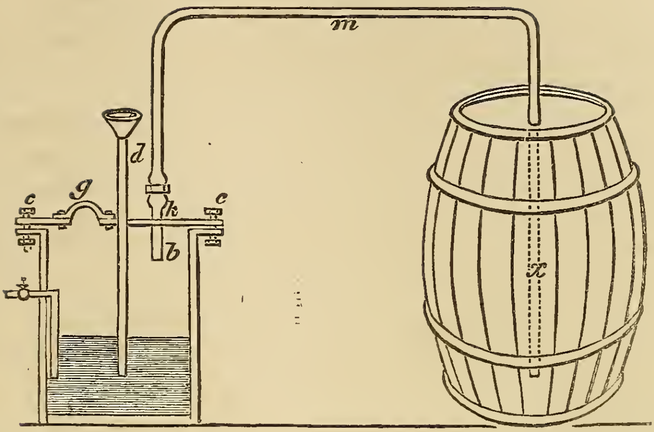
Boëttger has proposed to depilate all kinds of hides with the hydrosulphate of lime, in paste, which is prepared as we shall see hereafter. To use it, the skin is put, with the hair up, on a table, when the hair is slightly impregnated with the paste, so as to penetrate as far as the roots. In the same way is treated a second hide, which is placed on the other. These two hides are covered with a board loaded with stones. Two hours after the hair is transformed into a kind of soap, which is easily removed.

Preparation of the Hydrosulphate of Lime.

The hydrosulphuret of calcium, or hydrosulphate of lime, when it is not convenient to obtain it from gas-works, is prepared by saturating a very thick milk of lime with sulphuretted hydrogen gas. The necessary apparatus is shown on page 289.

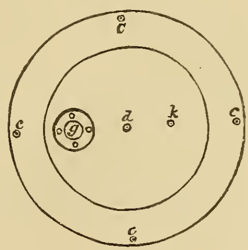
Fig. 78 represents a leaden generator, of cylindrical form, thirty-six inches high by twenty-four inches in diameter, supported by a wooden jacket. This vessel has a movable cover of cast iron, with a projecting ledge, through which pass the

Fig. 78.



bolts c, c, for fastening it down. In this cover there are three openings, as shown in Fig. 79. The larger one, g, is the man-hole for the admission of the sulphuret of iron and for cleaning out. Of the two smaller, the one, d, receives the stationary funnel tube, d, through which the dilute sulphuric acid is to be introduced. The side hole, k, contains a short tube, b, with a screw at its upper end for coupling the flexible exit tube, m (made of vulcanized rubber), which is to convey the generated gas into the lime paste contained in the closely covered receiver, x. A pipe running down the side of the generator, interiorly, is for the coupling of the steam pipe when the admission of steam is necessary.

Fig. 79.



The protosulphuret of iron rests upon the bottom of the generator. When the sulphuric acid and water (one vol. of the former to three or four of the latter) are poured in through the funnel tube, d, to the height indicated in the figure, chemical action immediately ensues. The water, which is composed of oxygen and hydrogen, is decomposed, and the former gas goes at once to the iron, which is deserted simultaneously by its sulphur, and thus becoming an oxybase indulges its affinity for

the sulphuric acid and unites with it to form sulphate of iron. The hydrogen unites with the sulphur to form sulphurretted hydrogen, which escapes through the tube, *m*, leading into the milk lime with which it combines as hydrosulphuret of calcium. The current of gas is continued until the lime is saturated. When the current of gas slackens, hasten it by the addition of a little acid and water. The occasional admission of steam facilitates the reaction. When the paste is saturated, stop the connection of the tubes *m* and *k*, and the generator is emptied by the man-hole, *g*, so as to be ready for another operation.

The receiving vat should be of wood, strongly bound with iron hoops, and fitted with a cover and appliances for keeping it close enough to confine the gas, but not so tight as to cause an explosion.

The paste should be made in quantities as required, for it must be used immediately, as the action of the air soon converts it into sulphate of lime.

Depilation by Caustic Soda.

M. F. Boudet, as a substitute for lime, for raising and depilating hides, proposed caustic soda. For this purpose the liquid is prepared by decarbonating a very dilute solution of soda ash with a sufficient quantity of lime, allowing repose, and decanting the clear supernatant liquor of caustic lye. Hides immersed in this liquor swell out rapidly and considerably, and are ready to scrape in two or three days. Moreover the alkali forming soluble salts with the fatty portions, facilitates the cleansing, and produces a smoother grained side than is common. Hides thus prepared imbibe the tan liquor more rapidly than those which have been treated with lime. They undergo the entire process of tanning in much less time, and suffer less loss than those prepared by the usual method. Forty-four pounds of sal-soda dissolved in one hundred and thirty-two gallons of water, and mixed with thirty-three pounds of slacked lime, suffice for steeping two thousand two hundred pounds of fresh hides.

Section III. Depilating by Sweating.

In the preliminary preparation of sole leather we use the "cold-sweat" process, while in Great Britain and other portions of Europe, the warm-sweat method is employed; but for the production of upper leather, the hides are limed about as we do.

Dry flint hides are the ones that are usually prepared in this country by the employment of the sweating process for depilating, and it is highly essential that the hides should be properly soaked, and all their parts be thoroughly softened before they are subjected to the sweating process, for if not intelligently prepared, they harden in spots, forming "old grain."

"Frieze" is principally caused during the process of sweating when the grain of the hide is inclined to be tender and has the appearance of being scraped off. "Black spots" or "old grain" are blotches of dark color, and when the hide is tanned, rolled hard, and finished these spots cannot be buffed off, and sometimes they extend over the whole side of leather, as has been stated in the chapter treating of the washing and soaking of hides.

Cold Sweating Process.

This process, much used in New York, New Hampshire, and the northern part of Pennsylvania, has all the advantages of the older processes. It gives a gain in the leather over the warm sweating process and the liming.

The process is as follows: A vault, pit, or building is prepared for the reception of the hides. The walls may be built of brick, stone, or of a planked frame. There should be one alley for entrance six feet long, having a door at each end, the outer one made double, and filled in with spent tan, to prevent the communication of warm air from without. A ventiduct, made of planks ten or twelve inches square, should extend from the centre of the bottom three or four rods therefrom, and placed not less than four feet below the surface of the ground. This serves both as a drain for discharging the water of the vault and to admit damp, cold air, to supply the place of that which

has become rarefied, and thus keep up a current through the ventilator at the top. The ridge of the roof if a vault is used may be level with the ground; and on the ridge, extending its whole length, set up two planks edgewise, two inches apart. The space between these is to be left open, but the remainder of the roof must be covered with earth, to the depth of at least a yard. The earth covering upon the vault and drain is to preserve a low temperature for the hides so that they may unhair without tainting.

Spring water should be conducted either in pipes or logs, around the angles formed by the ceiling with the walls of the vault, from which water should be allowed to flow in small quantities, either forming a spray, or falling so as to raise a mist or vapor, and saturate the atmosphere of the vault. The temperature of spring water is generally about 50°. Water evaporating at all temperatures, it is plain that if a constant supply be afforded, this evaporation, by requiring a large portion of heat, would keep the temperature of the vault nearly uniform. To suspend the hides in the pit, place three bars lengthwise, at equal distances, near the ceiling with iron hooks, two or three inches apart, inserted therein. Soak the hides as usual for breaking, then hang them singly upon the hooks by the butt, so that they may be fully spread open. In the course of a few days, when the hair begins to loosen upon the upper parts, take them down, raise the middle bar, and hang them by the other end until they easily unhair. The hides should not be broken until they are taken from the vault and are ready to unhair. In a good vault where the thermometer ranges from 40 to 56° F., which it should never exceed, and where there is a free circulation of damp air, hides require from 6 to 12 days for unhairing. When the temperature falls below 44° F., the ventilator should be partially closed, and when it rises above 56° cold damp air must be forced in, or an increased quantity of cold spring water may be thrown from a hose.

Hides thus treated are free from all extraneous matters, and contain all their gelatin, albumen, and fibrin, in an unimpaired state. The action is confined to the surface or grain of the skin, expanding the outer portion, softening the roots of the

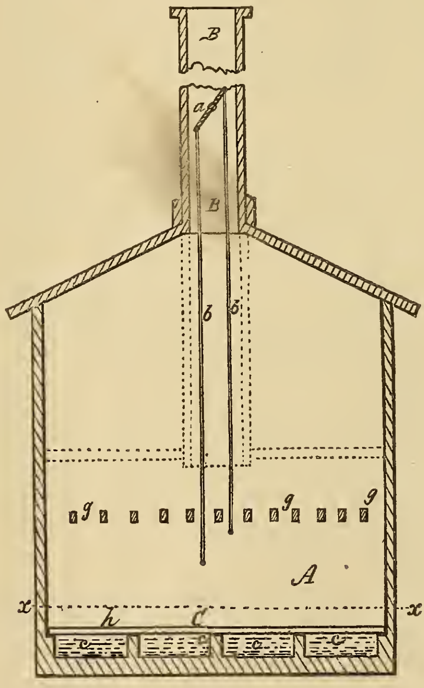
hair, and thus rendering its removal easy. The effect is due to the softening action of the vapor, and it is a simple case of absorption and swelling of the tissues of the skin and roots of the hair.

This process has been proved by experience to obviate many of the evils arising from hot sweating or from unhairing the hides by the lime process.

A Building for Sweating Hides or Skins.

The arrangement shown in Figs. 80, 81, and 82 for sweating hides and skins, is the invention of Mr. William M. Mason, of

Fig. 80.



Buffalo, N. Y., and the valuable points which it contains will be readily appreciated by tanners who employ the process of sweating.

Fig. 80 is a sectional elevation of a building embodying the

improvements. Fig. 81 is a horizontal section in line *x x*. Fig. 82 is a vertical section at right angles to Fig. 81.

Fig. 81.

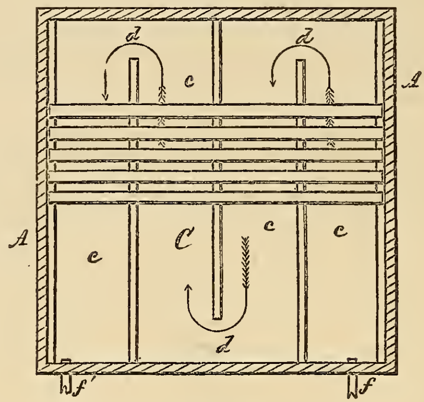
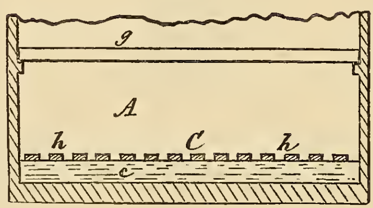


Fig. 82.



This invention consists of a vault or apartment having a ventilator provided with a regulating-valve, and a water-floor consisting of a series of communicating-troughs, arranged and operating as hereafter described, for the purpose of softening dry hides and sweating the same.

In the drawings, *A* represents a building of any kind, and *B* is a ventilator at the top. If the whole building is used as the vault, the ventilator simply extends from the top, as in black lines, Fig. 80, but, if only one story is used, the ventilator is extended below and passed through the flooring, as shown by the dotted lines, thereby leaving the upper story or stories free for other uses. A valve, *a*, is preferably hung in the ventilator at any point, and provided with cords *b b*, by which it is operated. The use of the valve is to graduate the escape of the cur-

rent from the interior, by closing more or less of the ventilator space. Any desired number of the ventilators may be used, and they may be extended to any desired height, the latter being preferable as it produces an active ventilation. A water-floor, *C*, is employed, to which is applied water to produce the evaporation. The inventor prefers the form shown, which consists of a series of troughs or water-ways, *c c c*, open at alternate ends, as shown at *d d*, so as to form a zigzag water communication around, as indicated by the arrows in Fig. 81. The water enters by an induction-pipe, *f*, at one end, and escapes by the eduction-pipe, *f′*, at the other end. This current or flow of the water is essential to discharge such gases as are absorbed by the water and keep the water pure. Either fresh or salt water may be employed; but the latter is preferable, especially in hot weather, as it produces a colder atmosphere, and the salt acts as a preservative to the hides in sweating. A different arrangement of the water-floor and its troughs may be used, and the throwing or spraying of the water on the floor might be used with a similar effect. *g g g* are the slats or poles for hanging the hides. *h h h* are slats laid as a flooring over the water-troughs, with interstices left between to allow of the evaporation.

By the means above described, there is produced cold sweating in contradistinction to the warm sweating heretofore practised. By so doing, it is claimed that the requisite dampness is always obtained without any danger of heating and spoiling the hides. The ammonia and gases are all carried off as fast as they are generated, thus removing at once the great cause of putrefaction. There is, consequently, no loss of the hides from this source, and but little care or time is necessary in conducting the operation, as compared with the usual method.

Any arrangement of doors, windows, or other apertures or entrances may be used, and the vault may be so arranged that an opening may be made in the same at the bottom at any time, for the purpose of admitting air to assist the ventilating action when the atmosphere is heavy, as is sometimes the case.

Care to be Observed in Sweating Hides.

Some tanners prefer to maintain the temperature for the sweating pits at from 60° to 70° F.; but the risk increases largely in proportion to the increase of temperature.

Faithful attention should be paid to the hides during the advanced stage of sweating, and when any give indications of advancing too rapidly they should be removed to the bottom of the pit, and properly cared for.

When the sweating process is used for small hides or kips, they should be thoroughly washed in very clean water, spread out after four days' soaking, well rinsed and drained, then laid together in packs in such a manner that the hair is outward, and the pairs of skins back to back. Hang them over the poles of the sweating pit, with the tail end upon one side, and the head on the other. Then close the door and stop it up well so that the air may be excluded as much as possible, and leave matters thus until the odor of the sweating process becomes quite strong, which is an indication that the process of depilation is about to begin, and from this time out the greatest attention should be paid to the stock.

The working of the sweating process is shown by a sharp lye which forms under the hair, and which drops off the instant fermentation sets in.

Light hides should not be placed in too strong lime; these hides should rather be operated upon by degrees and always with weak lime, after coming from the sweating vault.

The sweating process regulates and hastens the expansion of the hide, opens the pores, and places the hide in a state similar to that in which it was at the time the animal was slaughtered. To prepare it for the leather dressing process, it will be found enough to work the hide lightly on the flesh side with the iron, when it is taken out of the sweating vat, so as to stretch out the wrinkles that may appear before the hide is placed in the lime-pit, which, as has been said, should always first contain a weakened lime bath.

With regard to the large hides, such as those imported from South America and elsewhere, we urgently recommend that

they should be subjected to the sweating process for, we repeat it, the sweating system has not only the effect of facilitating the process of depilation, but of giving to dry wild hides that development of which they stand in need.

Buenos Ayres hides are a species of hide which softens easily and in a regular manner. It is admitted that hides which are allowed to remain continuously in water soften less readily than those which are alternately soaked and piled. And now let us consider how piling compares with sweating. Piling is nothing more nor less than a slow inward sweating, and while it is slow you run the risk of having the edges damaged, by giving the time necessary to effect a good result. So in order to save the back and extremities you are obliged to dispense with a complete softening of the hide, and moreover lose time, which is always the result of irregular soaking. We seek to attain in soaking the hide the raising up of the fibres, in order to save those parts of the hide which were wet, and became dried during transportation; and the best mode of doing this consists in accelerating the operation, so as to obtain a thorough soaking by the sacrifice of from seven to eight days.

Stagnant water does not give the dry hide time to become completely softened again, at least it injures the grain, which becomes lost before the water has had time to penetrate the fibres of the hide.

Under these circumstances, sweating is alone of use, and if necessary, a softening during twenty-four hours in open water will be sufficient to secure a satisfactory result, as experiment has proven.

Soak the hides in water for twenty-four hours, mark the flesh side well, and rinse the hair side thoroughly, so as to rid it of all foreign substances, so that no faulty spots may ensue; let them drain in a heap during four or five hours, and bring them to the sweating process as above described. Sprinkle them with fresh water from a gardener's watering-pot, provided with a sieve-like spout, and after the hides have been again allowed to drain off, put them back in the sweating vat.

Three sprinklings with the watering-pot will be found ample, in combination with the sweating process, to soften the driest

and oldest hides to such a degree, that, even if they are of the heaviest, they can at once be divested of the hair. Then separate them after rinsing them, lay them again in water, clean and scrape them, and do not interrupt the gradual course which the hide has to undergo.

What we have last above stated should only be resorted to when suitable water is wanting for proper soaking, for we recommend above all things that the hide be carefully soaked in water, as this raises it well, but in all cases, whichever mode of soaking be followed, the hides should never, as a general rule, be allowed to stay in the water longer than four days, or from five to six days in severely cold weather. Of course the sprinkler with a watering-pot is then superfluous, and there will then only remain the placing of the hides in the sweating vat to be attended to. They should be left in it from four to six days, according to the season of the year.

The Warm Sweating Process.

The process of warm sweating largely employed in Germany and many other portions of Europe is usually conducted in a buried box of suitable size, from which the air is rigidly excluded. The box has racks firmly attached to the sides, opposite each other, and into which stout notched poles are fitted to receive the hides after they are properly rolled. The cover of the box is usually composed of loose boards, which are convenient for handling in filling or emptying the sweat-box.

After removal from the water and draining off for a few hours, the hides are placed, hairside out, alongside the sweat-box, and the sides folded in towards the back, or the hides are rolled together from the side towards the back.

If the sweat-box is of a sufficient depth, folding in of the head is not necessary, but otherwise it has to be done to prevent the hide from touching the bottom of the box. To keep the head from sliding out, which might easily happen, both ends of the rolled hide are securely tied with twine. After covering the bottom of the box with a layer of spent tan three or four inches thick, the hides are hung close together over the above-mentioned poles. The box is then tightly covered with boards

upon which, to prevent all access of air, tan is piled to the depth of about ten or twelve inches, and well trodden down. Warm steam is frequently used in order to accelerate the sweating process. Though this method offers some advantages, great risk is connected with it and the utmost care must be exercised to guard against overheating. Spontaneous heat, which is generally developed in five to six days, is always preferable, as it acts more uniformly than heat produced by steam.

After remaining in the sweat-box for a few days, the condition of the hides is examined by removing the tan from one corner and pushing a board far enough back to allow the introduction of the hand. If after examining several hides, it is found that no heat has been developed and the hair not loosened, the box is immediately closed. With some experience and skill it is an easy matter to determine how long the hides will still have to remain in the box; fourteen days being frequently required before the hair becomes loose. The greatest care and precaution are necessary during the entire sweating process, as putrefaction promoted by heat makes rapid progress and may cause great loss.

Sweating fresh Hides.

After cutting out the horns, fresh ox hides intended for sole leather are spread out and thoroughly salted upon the flesh side. After folding each hide in the middle from head to tail and tucking in the hoofs, sides, and head, it is formed into a pack. Several of these packs are then piled upon one another and covered with woolen covers or straw. It is best to perform these operations in a cellar.

It is advisable to use three pounds of salt for a large hide, as this quantity is required to protect the flesh side against putrefaction, and besides makes the hide more solid. After twelve to sixteen hours the hides are turned. The packs are taken apart, the hides refolded and again piled up and covered, after which they require turning only every three or four days. By this method the hair becomes loose in two to three weeks.

Fresh salted hides are generally not subjected to the sweating process, it being preferred to place them, after thorough

soaking in water, in weak lime, when the hair becomes sufficiently loose in from six to eight days to allow of the hides being unhaired.

Section IV. Other Methods of Depilating now nearly obsolete.

The other methods of depilating formerly practised by the tanners of Europe at times, were raising by barley and other grain dressings, and sour tan-liquor. The first is accomplished by placing the hides in a series of vats having a regular graduation in the strength, for instance, five hides are placed in the first vat where they remain twenty-four or twenty-eight hours, and are then transferred to the second, which is slightly more sour, and so successively through all the vats. After the skins have been treated properly they are washed in clear water for the removal of the dirt, and when they come to the last dressing they are rinsed and scraped over with the fleshing knife; at last they are again put in water and brushed over on the hair side.

Some, after this manipulation, lay the hides in the vats, but many persons subject them at first to a red dressing. This dressing is given by spreading the hides in a vat, one above the other, and placing between each pair two or three handfuls of ground bark. They add water until the hides are submerged. This process requires two days, and the hides require only one withdrawal to allow them to drain.

In giving the finishing wetting, care must be observed to supply bark where it is wanted.

This method of cleaning and unhairing presents as many objections as the lime process, and besides has other disadvantages. The efficiency of the bath is destroyed when exposed to a low temperature, and it is not resorted to when the bath thaws. The leather is in danger of being injured by the putrid fermentation of the materials.

In England, for coarse hides, they sometimes used the barley dressing, and completed the operation in six days. The hides passed through four or five dressings, and from the weak pro-

gressively to the strong. The hides remained 24 hours in the last vat, which was new, and had been soured for 15 days. It was made by mixing 60 lbs. of barley meal in hot water. As a long time was allowed for the development of acid, and consequently the dressing was more active than ordinary ones, it was necessary to watch carefully when the required point was reached, otherwise the hides would be injured.

Another method was to deprive the hides of hair by stacking them in heaps and promoting warmth by covering them with straw or manure, until the hair was ready to be removed. If it came off with difficulty upon the beam, its separation was facilitated by the use of sand spread upon the hair side. This method is disadvantageous and injurious to the skins.

Raising by Sour Tan Liquor.

This process is still employed to a very moderate extent in France and Germany for depilating, and is conducted about as follows:—

The skins are soaked for 24 hours in fresh water, and carefully fleshed and deprived of all superfluous parts. When perfectly clean and well rinsed, they are deposited in the liquors by which they are to be swelled for depilation. These liquors are contained in a series of eight or ten vats made of oak, hooped with iron; they are 3 feet 8 inches in depth, and 5 feet 5 inches in diameter. In each vat deposit seven or eight skins, and cover them completely with the liquor.

Let them soak 24 hours in the first vat, which contains the weakest liquor, and during that time take them out twice to drain for one hour, the skins being placed on boards which are inclined so that the fluid dripping from them runs back into the vat. After two days take them out, let them drain one hour, and place them in the second vat, which contains a stronger infusion. The same operations are repeated daily until the skins have passed through all the vats. If at the end of this time the hair appears ready to fall off, it is removed from the skins by working them in the ordinary manner upon the beam with the unhairing knife. In cold weather it is sometimes the case that the process has not been sufficiently completed at the end of the time

mentioned, and that the skins require exposure to the strong liquors for five or ten days longer, in order that the hair may be removed with facility.

The skins are then "plumped" and treated for the reception of the tanning liquor.

Raising by Yeast.

Yeast has the property of raising hides and skins, and has been used for this purpose. It is mixed in a vat with warm water, the vat is covered, and fermentation takes place. When this is fully established, a quantity of salt is thrown in, and the skins are deposited in the vat, the contents of which are then treated precisely as in the case of barley dressing. The operation can be conducted in the cold, but is much more rapid and successful if the temperature of the liquor be kept elevated.

We have given the above now nearly obsolete processes to satisfy manufacturers, rather than to induce them to use them; for the dressings with barley, and generally with grains, are not followed now, on account of the influence of the temperature upon them, and the great liability of the hides so treated to become putrefied, or injured by the undue fermentation of the materials employed.

List of all Patents for Compounds for Depilating[1] *Hides and Skins, issued by the Government of the United States of America, from* 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	June 30, 1836.	J. Banks,	Dixmont, Me.
336	July 31, 1837.	B. F. Emery,	Bath, Me.
2,096	May 15, 1841.	F. and H. Robinson,	Wilmington, Del.
2,842	Nov. 4, 1842.	J. W. Cochran,	New York, N. Y.
12,151	Jan. 2, 1851.	A. H. Ward, Jr.	Boston, Mass.
12,369	Feb. 6, 1851.	Z. W. Fiske,	Louisville, Ky.
17,562	June 2, 1857.	A. K. Eaton,	New York, N. Y.
29,392	July 31, 1860.	D. Lufkin,	Cleveland, O.
35,293	May 20, 1862.	J. Brainard,	Cleveland, O.

[1] Such patents as No. 144,150 for depilating or removing hair from scalded hogs by machinery, and Nos. 121,565 and 141,972 for depilating by pulling wool from pelts by machinery, will be found under the list of patents for unhairing machines.

No.	Date.	Inventor.	Residence.
52,464	Feb. 6, 1866.	B. F. Taber,	Buffalo, N. Y.
59,627	Nov. 13, 1866.	J. M. Muller,	North Becket, Mass.
78,543	June 2, 1868.	P. G. Schlosser,	Middletown, Md.
86,506	Feb. 2, 1869.	L. Clozel,	Grenoble, France.
92,179	July 6, 1869.	A. Fau and E. Fau,	Castres, France.
99,387	Feb. 1, 1870.	G. W. Adler,	Philadelphia, Pa.
104,734	June 28, 1870.	J. Henry,	New York, N. Y.
116,638 Reissues 4,449 4,550	July 4, 1871. Sept. 12, 1871.	J. E. Siebel,	Chicago, Ill.
120,606	Nov. 7, 1871.	R. P. Wilson,	New York, N. Y.
123,598	Feb. 13, 1872.	J. Watteau,	Antwerp, Belgium,
123,748	Feb. 13, 1872.	C. J. Tinnerholm,	Quincy, Ill.
125,020	Mar. 26, 1872.	A. C. Keith,	Jersey City, N. J.
131,927	Oct. 8, 1872.	Wm. Anderson,	Inverkeithing, G. B.
136,081	Feb. 18, 1873.	Wm. Maynard,	Salem, Mass.
136,082	Feb. 18, 1873.	Wm. Maynard,	Salem, Mass.
136,488	Mar. 4, 1873.	J. Carter and A. C. Keith,	Jersey City, N. J.
145,436	Jan. 10, 1871.	Wm. M. Mason,	Buffalo, N. Y.
153,636	July 28, 1874.	C. J. Tinnerholm,	Chicago, Ill.
158,608	Jan. 12, 1875.	C. J. Tinnerholm,	Keokuk, Ia.
158,648	Jan. 12, 1875.	H. Mower,	Camden, N. J.
165,348	July 6, 1875.	E. Manasse,	Napa, Cal.
176,606	Apr. 25, 1876.	J. L. De Montoison,	Manchester, Eng.
181,061	Aug. 15, 1876.	Wm. Farris,	Yarmouth, Me.
196,672	Oct. 30, 1877.	J. Kent,	Gloversville, N. Y.
211,532	Jan. 21, 1879.	C. J. Tinnerholm,	Brooklyn, N. Y.
223,200	Dec. 30, 1879.	J. Wells,	Wilmington, N. C.
226,447	Apr. 13, 1880.	J. Foley,	Montreal, Canada.
236,860	Jan. 18, 1881.	C. J. Tinnerholm,	Brooklyn, N. Y.
257,442	May 2, 1882.	J. Head,	Hornellsville, N. Y.
262,924	Aug. 22, 1882.	J. B. Bollman,	Dayton, O.
281,287	July 17, 1883.	J. L. Moret,	Paris, France.
285,044	Sept. 18, 1883.	A. Laure,	Mazamet, France.
287,255	Oct. 23, 1883.	A. H. Stone,	New York, N. Y.

CHAPTER XVI.

UNHAIRING AND FLESHING—UNHAIRING BY THE HAND PROCESS —FLESHING BY THE HAND PROCESS—SOAKING HIDES AFTER FLESHING—UNHAIRING AND FLESHING BY MACHINERY—LIST OF AMERICAN PATENTS FOR UNHAIRING AND FLESHING MACHINES.

SECTION I. UNHAIRING BY THE HAND PROCESS.

IN this country the unhairing and fleshing of hides is accomplished both by hand and machinery. The hand process is still the general manner, and we shall consider it first and the machine process afterwards.

The operations are conducted in the "beam-house," an interior view of which showing the forms of beams employed and other details is given in Fig. 83; the German form of beam and stand, used in tawing establishments for skins is shown in Fig. 84, and the unhairing knife in Fig. 85.

After loosening the hair, the hides, if they have been subjected to the sweating process, are removed from the sweating vaults, drawn through fresh water, and allowed to drain. This operation prevents drying, promotes cooling off, and interrupts putrefaction, and as hides thus treated will usually keep for two days without suffering damage, unhairing need not be hurried.

Limed stock is taken from the "limes" directly to the unhairing beams and not passed through water as in the case of hides that have been subjected to the sweating process.

The "unhairing" of hides and skins is usually effected by placing them upon a beam and scraping the hair off with a concave blade called the "unhairing knife," which agrees with the curvature of the beam, and the operation is performed by men of great physical strength, endurance, and skill, acquired only by long and continued application; but this manner is too slow to

Fig. 83. Interior View of a Beam House. Page 304.

meet the large and constantly increasing demand for leather, and consequently aids in rendering this material too dear for a commodity of such varied and indispensable employments, and in order to facilitate unhairing a large number of machines have been invented both in this country and in Europe.

Fig. 84.

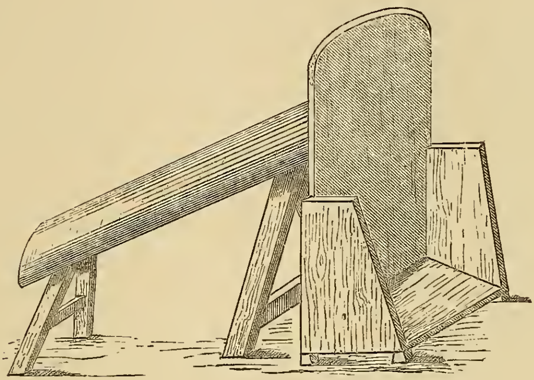
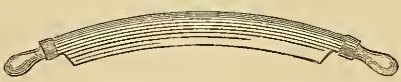


Fig. 85.



To offer increased resistance to the tool in the hand process, very fine sand, or road dust, mixed with a small quantity of ashes, is sometimes rubbed into the places where the hair is difficult to remove; but this practice is injurious to the grain and should not be employed.

As depilation is more easily accomplished by pushing the knife against the hair, the sides from the hind hoof towards the head are first operated upon and then towards the back.

Fresh hides are operated upon as soon as the hair can be pulled out around the hoofs, and from the upper part of the head.

After depilation the hides are again placed in water, and rinsed and left to remain over night, after which they are usually ready for fleshing.

In the process of unhairing hides and skins sometimes some

of them are cut or so injured that they are reduced from the first quality to a lower grade, and thus loss is occasioned. It is well known also that after the hair has been removed by the usual process of liming and scraping or rubbing it off, there remains a short fine hair or fur, and also hair on the edges and extremities of the hide, which has to be removed generally during the scouring by a sharp knife or other instrument called the "short-hair knife." The chief mischief is done to the hides in removing the fine hair by cutting or clipping the grain of the hide, and when this is too frequently done a guard should be attached to the knife in order to prevent the possibility of damaging the skin, especially when it is intended for delicate work.

This knife is made of steel, like ordinary knives, with the usual handle, but for convenience the blade may be made with a double edge, the under side of which is somewhat convex, being thickest in the middle and gradually decreasing in thickness to the edge. The upper side of the blade may have a dovetail rib in the middle or thick part of the blade, and from this rib to the edge on either side the blade should be somewhat concave.

The guard is made with a dovetail groove, so as to slip closely on to the rib. It is made of German-silver, brass, copper, or any suitable metal or material, and should project beyond the edge of the blade about the sixteenth part of an inch. Its edges should be thick enough, or slightly corrugated on the inner side, so as to give it requisite stiffness.

When the knife needs sharpening the guard may be easily slipped off and also ground down if necessary.

The concave side of the blade and the openings of the guard allow the hair to pass off without inconvenience.

The knife is used in the same way as the ordinary knife, and is of great value in cleaning kid-skins and other varieties of skins used for glove leather, where so much care has to be exercised to prevent clipping the grain.

In France particular attention is paid to the beam work on calf-skins, and we will describe the process of unhairing and fleshing as practised in that country.

The beam-house is so arranged as to avoid loss of time for the workmen in taking out of the vats and putting back the skins they are working.

They have at least three vats for five or six beam-hands; these vats have a capacity of 375 or 400 gallons each; the water runs into and out of them with rapidity so as to fill and empty them promptly.

The unhairing beams are five feet long, and are covered with strong sheet zinc, and thus have a smooth surface convenient for the work of the operator, and which avoids breaks and knife cuts on the grain side.

The sheet of zinc is 3 ft. 4 in. long and 2 ft. 1 in. wide; the beam presents a convex line of $7\frac{1}{2}$ inches rise. The zinc is fastened with round-headed tacks well nailed down, and must be put about $1\frac{1}{4}$ inches below the head for the following reasons: It often happens that it is necessary to put for dripping 25 or 30 skins on the same beam and to leave them on it for several hours, in which case the undermost hide which rests on the edge of the head of the beam will have a deep curved mark pressed on the neck, and this mark cannot be taken out in tanning or even in currying. The grain at that spot looks like parchment and refuses to take the tannin. A prominent French tanner tried to discover the origin of these spots, and found that they had been caused by the sharp edge of the beam-head, and he put the zinc about $1\frac{1}{4}$ inches further down, and from that time he did not find any more of these creases which had previously spoiled the skins and diminished their value.

The beam for fleshing the skins and for thinning the neck is broader, and less arched than the other; it is lens shaped. This facilitates the work of the knife, for by having a broader surface, the edge is less liable to slip and make flaws, and the work progresses more rapidly, as the operator is not forced to change the position of his calf-skin so often, and when he reduces a throat or a head, he does so in a more uniform manner.

To unhair slaughtered calf-skins fresh from the Paris market, the workman lays two large skins at a time on the beam, and when of medium size places three; but when the calf-skins are

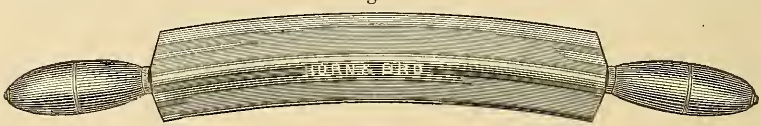
small, places four. In order to avoid scratches and to make the action of the knife easier, the workman gives great care to the edge, and leaves no trace of hair upon them. He then places them in water, and rinses them.

Next a skilful workman cuts the navels and nipples, trims the rumps, fashions the breeches and the tails, going entirely around the skins and reaches the neck, which requires special treatment. Should there be any flesh left by the butcher on the flanks and necks it is lightly removed with the fleshing knife.

Section II. Fleshing by the Hand Process.

This operation, which consists in removing all fleshy and fatty matter by means of a sharp blade, requires great skill. In some tanneries the work is performed with a fleshing knife having a curved blade, which measures about seventeen and a half

Fig. 86.



inches between the handles for the kind used for hides, and about sixteen and a half inches for skins; this form of flesher is shown in Fig. 86.

A workman once accustomed to handling this tool can turn out very clean work, but it is far better to use for this purpose

Fig. 87.

the so-called German fleshing knife, which has a blade measuring from twenty to twenty-three inches between the handles, and about an inch and three quarters wide, and which is shown in Fig. 87.

The German, or spring fleshers, are especially recommended

for extra clean work, they make a more satisfactory cut than the other styles of fleshers, as the workman is able to readily adjust it to the curved shape of the beam, which is a great advantage over the stiff straight-edged flesher cutting on an oval or convex surface.

The spring pating fleshers measure about seventeen inches between the handles.

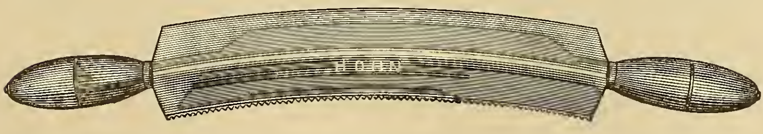
In the commencement of fleshing a hide is laid escutcheon part down over the beam, and shaved the entire width of the beam and as far down as the workman can reach, this hide forming a support which is later on replaced by one entirely shaved. The hide to be fleshed next is laid, head down, over the beam, and after shaving it, first the entire width of the beam and next the sides, it is turned over and finished by shaving the escutcheon. In fleshing the left hand precedes the right, and, to prevent injury to the hide by cutting into it, the workman should accustom himself to drive the knife without stopping, as far as he can reach from the top to the bottom of the beam.

The projecting filaments or shreds, and those parts of the borders of the skin which are thicker than the rest, are cut off with a sharp knife and the portions thus removed are sold to the glue manufacturer.

For the removal of butcher cuts not accomplished by fleshing the smoothing stone often proves a great advantage.

The saw-toothed flesher sometimes employed for dry hides is shown in Fig. 88.

Fig. 88.



The turning steels employed are round and three square, sometimes the latter style is file cut on one side. The three square plain turning steel is shown in Fig. 89.

In the portion of this chapter devoted to the unhairing of calf-skins, page 308, the manner of cutting the navels and

nipples, and trimming the rumps, etc., of calf-skins was described. Following this operation the flesh sides are gone over with the "worker," the skins being pushed crosswise or diagonally, start-

Fig. 89.

ing from the humps of the shoulder. Large calf skins are put on the beam one at a time; but two skins are put at once on the beam if they are of medium size or thin.

In order to have this work done successfully the workman must, by means of short and brisk blows, applied in a kind of moving fashion, get off by main strength all the fleshy and parchment-like tissues, from the body of the hide and from the sinews of the fore and hind legs.

The action must be brisk and vigorous on the crupper where the nerve of the hide must be entirely broken; go over lightly on the fore and hind flanks without even trying to take off the tissues with which they are covered; the collar must also be managed carefully; the action must be brisk on the necks and heads if there are any tissues.

In acting in this way the nerves of the hides are completely broken on their sinewy parts, and due consideration is given to the weak or hollow spots.

This work is very important, and must be overlooked with great care, as the skins that are not worked in the way just explained, but which are merely and indiscriminately scraped for flesh, never develop themselves well in tanning, refusing to absorb the tannin and give poor results in the currying.

When all the skins have undergone this process they are put to soak for six hours in a vat of clear water.

Then they are next counter-fleshed, putting two hides at once on the beam; they are again soaked in water for an hour or two; they are taken up and gone over with the "worker," putting two large skins on the beam, or more if they are small; the flesh side to be upwards. It is very important to have this operation well done with the "worker," slight blows at first,

then heavier, in order to empty and purify them of lime; then the grain is cleaned with a knife of which the bevel must be very smooth in order to avoid scratches.

After these two operations the hides are put to soak in clean water for three or four hours. They are then taken in hand again and given a last working of the grain *on the body of the hides only;* are rinsed for the last time, and piled awaiting storage in the vats.

It requires a sure hand to do the fleshing of a calf-skin. The work must be done in mowing fashion only, as straight heavy blows are apt to enter the skin and leave marks of cuts. The butchers do generally enough mischief to the hides without the tanners adding any more. It requires then some knowledge and experience to avoid all mishaps; and furthermore the tanners' is a rough trade and it requires a pair of stout, hard and vigorous arms to make a good beam-hand.

Section III. Soaking Hides after Fleshing.

This operation exerts a great influence upon the quality of the leather, and is much more highly esteemed in Germany and France than in this country.

After fleshing, the hides are placed in water as clean and clear as possible, and if running water is used a location where there is but little current, or none whatever, is chosen. If a river or creek has to be used for the purpose, a pole is driven perpendicularly in the bottom of the river upon which the hides are successively strung through the ear hole and pushed towards the bottom, care being observed to keep them spread out horizontally. If the water is deep enough as many as twenty hides may be suspended one above the other. To give a better support to the pole the end projecting above the water is pushed through a strap secured to the bank of the river.

The hides are drawn up twice daily by means of a hook, rinsed off, moved and replaced in the manner described.

Soaking Hides in a Steeping Cistern after Fleshing.

In tanneries located on a river or connected with a water conduit, provision is generally made in Germany and France for steeping cisterns, which are of great advantage for the preparation of sole and upper leathers. They are constructed either of stone or wood and so arranged that the water can be admitted and drawn off very rapidly at will.

After fleshing the hides are placed in the steeping cistern previously filled with fresh water. After 12 hours they are moved, the water is drawn off, and the hides, after the admittance of fresh water, are replaced in the steeping cistern. This operation should be scrupulously repeated twice daily to prevent putrid soaking from making its appearance to the injury of the hides. By putrid soaking, which is recognized by a foul odor of the water, we understand the assumption of a flabby condition by the hides, while, on the other hand, with a fresh and sound soaking, they feel firm to the touch and smooth upon the grain side, and the water has no odor whatever.

How long should the Hides soak after fleshing, and what indicates their readiness for Scouring?

In this country the hides, after fleshing, are soaked for a much shorter period than in Germany and France. Hides intended for sole leather, with us, are generally allowed to soak over night, while in the countries which have been named, the time for soaking is from three to five days, the period depending much on the temperature of the water, the hides meanwhile being frequently examined as regards their readiness for scouring. They are ready, 1st, when the fine film still adhering on places after fleshing can be readily detached by scraping with the finger nail, and 2d, when by pressing with the fingers upon the grain side the indented places remain visible. As these indications can be most readily perceived after rinsing, it is well to make the tests after each rinsing operation.

Hides intended for the production of upper leather after being "green shaved" are placed directly in a bate of hen manure and worked for 8 or 9 hours with a drench wheel, after

which for about 10 minutes they are worked in a wash-wheel, and are then worked over with a hide-working machine and are next placed in spring water to soak over night. It is conceded that the bate neutralizes the lime in the hide and leaves this class of leather more pliable than when it is subjected to long soaking in water, which while it will extract the lime imparts an undesirable harshness to upper leather.

SECTION IV. UNHAIRING AND FLESHING BY MACHINERY.

The processes of unhairing and fleshing hides as usually performed are the most laborious operations in the business of tanning and require the workman to be constantly in contact with cold, wet hides, which is very injurious to the constitution, subjecting most operators to disease and forcing many to leave the business. Attempts have been made to perform this operation by machinery.

The unhairing of hides and skins by machinery is now an accomplished fact, true there is still room for improvement in these machines, but in those that are generally accepted by the trade these improvements are of only minor importance. But such is not the case with fleshing machines and they are not generally employed, for in an extended visit to many of the largest tanneries in this country I saw but few fleshing machines at work. At one tannery located about four miles out of Boston, Mass., I saw two fleshing machines in constant operation in the beam-house; but in many other tanneries fleshing machines have been tried and abandoned, while in still other tanneries experiments were being made to convert them into "slating" or other forms of machines. The tendency to either "scab" or "slight" the hide is a principal objection to fleshing machines as a class, and the necessity of going over the edges and other portions of the hide by hand after it leaves the machine is another drawback, which deters tanners from employing them at present; and still another objection is that they work the hides too much in some portions and render them soft and flabby.

Larrabee's Unhairing Machine.

Larrabee's machine for unhairing and scouring hides and skins is shown in Figs. 90 to 95.

Fig. 90.

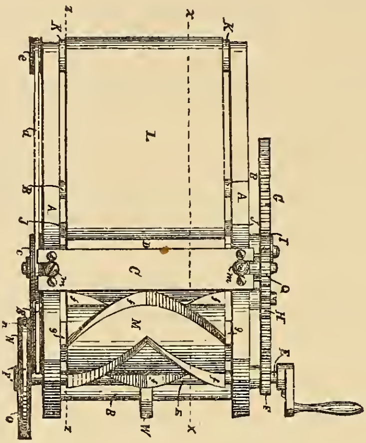
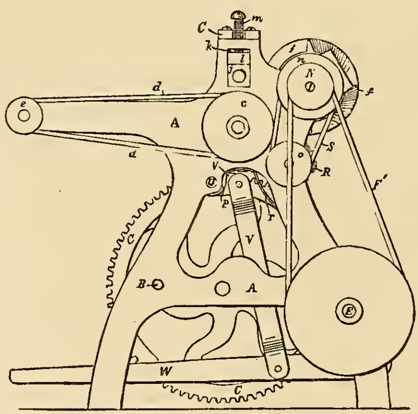


Fig. 91.



The operation of Larrabee's machine is as follows: The machine being set in motion, the operator places a hide or skin upon the apron, with the hair side up, spreading it out as smooth as he can thereon, the apron in the mean time carrying

the skin toward the drum *D* until its end comes in contact therewith, when the upward movement of the drum prevents the skin from being carried around the inner apron roll, and compels the skin to follow the movement of the drum, and

Fig. 92.

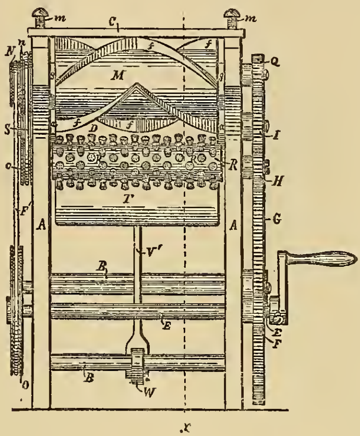
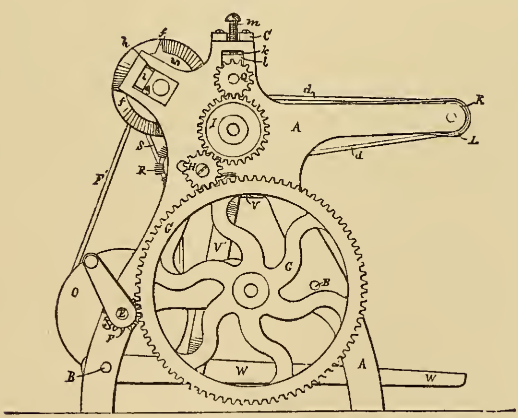


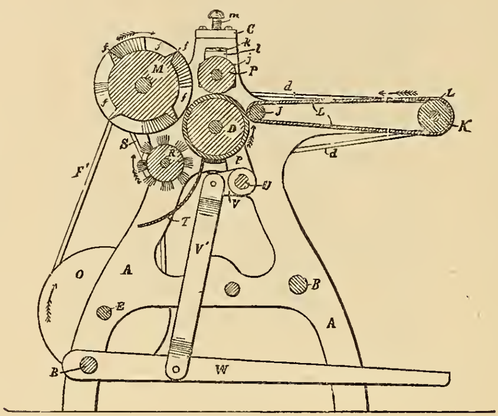
Fig. 93.



pass between it and the feed-roll *P*, where it is pressed hard upon the drum, and, being in a wet state, adheres firmly thereto, and is carried around thereby till it is slipped off by coming in contact with the shield *T*.

When the skin has advanced around the drum till its end is between the drum *D* and the knife-cylinder *M*, the operator places his foot upon the treadle, and, depressing it, causes the drum *D* to be moved toward the knife-cylinder till the edges of its knives come in contact with the surface of the skin with sufficient pressure to remove the hair, the knife-cylinder re-

Fig. 94.

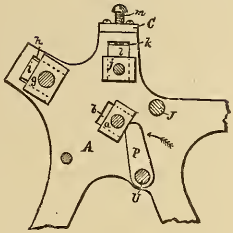


volving at a high rate of speed, while the hide or skin is fed forward quite slowly. The skin, continuing to adhere to the drum, is carried between it and the brush *R*, also revolving at a high rate of speed, for the purpose of cleaning the skin. The skin then comes in contact with the shield *T*, and is stripped off from the drum, and, sliding down the shield, is discharged from its end at any desired point.

Fig. 90 is a plan of Larrabee's machine. Fig. 91 an end elevation. Fig. 92 an elevation of the rear side. Fig. 93 is an elevation of the end opposite to that shown in Fig. 91. Fig. 94 is a vertical section on line *x x* on Figs. 90 and 92. Fig. 95 is a section on line *z z* on Fig. 90, illustrating the method of moving the supporting-drum toward the knife cylinder.

The side frames *A A* are connected by the tie-rods *B B* and girt *C*. The work-supporting drum *D* is covered with rubber, in order that its outer surface may be elastic and accommo-

Fig. 95.



date itself to any inequalities in the thickness of the hide or skin, the boxes *a a* in which this roll is mounted are detached and movable in the oblique slots *b b*, formed in the frames *A A*, and motion is imparted to the drum *D* by means of the driving-shaft *E*, and gears *F*, *G*, *H* and *I*.

J and *K* are two rolls, around which passes the endless apron *L*, having motion imparted thereto by the pulley *c* on the end of the drum-shaft, and the belt *d*, leading therefrom to and around the pulley *e* on the end of the shaft of the apron-roll *K*.

The upper surface of the apron *L* is placed some two or three inches below the level of the top of the drum *D*, so that the hide or skin will be presented to the drum by the movement of the apron at a point where the periphery is moving upward and backward, say at an angle of about forty-five degrees, the roll *J* being so placed that the apron, passing around it, shall move in close proximity to the periphery of the drum *D*, but not in actual contact.

M is the cleaning cylinder provided with the right and left hand spiral projections or blades *f f*, and mounted in the boxes *g g*, so arranged that the cylinder *M* may yield and accommodate itself to different thicknesses of hides and skins.

Rotary motion in the direction of the arrow is imparted to the cylinder *M* by means of the pulley *N* on the end of the cylinder-shaft, the pulley *o* on the end of the driving-shaft *E*, and the endless belt F^1, as shown in Fig. 91.

P is a feed-roll adapted to be adjusted by means of the set-screws *m m*, rotary motion being imparted to the feed-roll by means of the gears *I* and *Q*.

R is a cylindrical brush, mounted in suitable bearings in the frames *A A*, in such a position that its periphery shall be in contact with the surface of the drum *D*, or the hide or skin passing over and partially around said drum, for the purpose of cleaning the hide or skin after it has been acted upon by the knife-cylinder *M*.

Rotary motion is imparted to the brush *R*, in the direction

indicated by the arrows, by the belt *S*, leading from the pulley *n* on the shaft of the cylinder *M* to the pulley *o* on the end of the brush-shaft, as shown in Fig. 91.

T is a curved shield or guard extending across the machine below the drum *D* and the brush *R*, with its upper edge in close proximity to the under side of the drum, so as to serve the purpose of a "doctor-plate" to strip the hide or skin off from the drum, and also to direct the hide or skin to the desired position for discharge.

U is a rocker-shaft, having its bearings in the frames *A A*, and having firmly secured thereon two radial arms, *p p*, one near either end of said shaft, the outer or movable ends of which bear against the under sides of the boxes *a a*, in such a manner that a movement of said arms, in the direction indicated by the arrow, will cause said boxes *a a* and the drum *D*, having its bearings therein, to be moved obliquely in an upward direction.

It will be observed that the radius-arms *p p* and the rocker-shaft *U* are so arranged relative to the boxes *a a* that the radius-arms *p p* act upon the boxes more in the nature of a wedge moving in an arc of a circle than as a direct lifter, and that by moving one of said radius-arms around the axis of the rocker-shaft slightly, while the other arm *p* remains fixed, one end of the drum *D* may be raised or lowered, while the other remains stationary, for the purpose of adjusting the drum to the proper level.

V is another radial arm, also secured firmly upon the rocker-shaft *U*, and connected at its outer or movable end by means of the connecting-rod *V′* to the treadle *W*, so that the operator, by placing his foot upon the the treadle *W*, can move the drum toward the knife-cylinder.

Talpey's Unhairing Machine.

Talpey's machine for unhairing and scouring hides is shown in Figs. 96 to 99.

The operation of Talpey's machine is as follows: The table *G* is first moved into the position indicated by dotted lines in Fig. 96, when the hide or skin to be worked is spread evenly

thereon with the middle of its length over the slot *b*, when the table *G* is moved endwise in the direction indicated by the arrow *m*, by the operator or otherwise, till the stop *l* strikes the bar *E* and arrests the motion, when the carrier-plate *P* is made to move upward through the slot *b* of the table *G*, lifting the hide from the table by its middle, and carrying it upward between the cylinders $H\ H^1$, which are made to revolve toward each other, as indicated by the arrows *n o*, and at the same time are pressed against the hide by the weights *K K*, each of which acts independently of the others, so that if the hide should be thicker at one edge than at the other the cylinders will adjust themselves to the general surface of the skin, any small, short, or sudden variations in the thickness of the skin being compensated for by the independent yielding of the several sections or any one of them.

When the hide has passed up between the cylinders it may be removed from the plate *P*, and the cylinders $H\ H^1$ may be thrown apart by the operator pressing downward upon the end of the lever *N* while the carrier-plate *P* is returned to the starting-point.

Fig. 96.

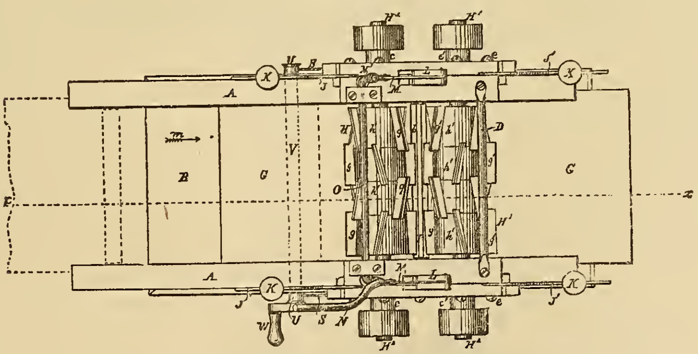


Fig. 96 is a plan of Talpey's machine. Fig. 97 is a side elevation. Fig. 98 is a vertical longitudinal section on line *x x* on Fig. 96, and Fig. 99 is a central longitudinal section through one of the knife cylinders and its barings.

A A are the side frames of the machine, connected by the

Fig. 97.

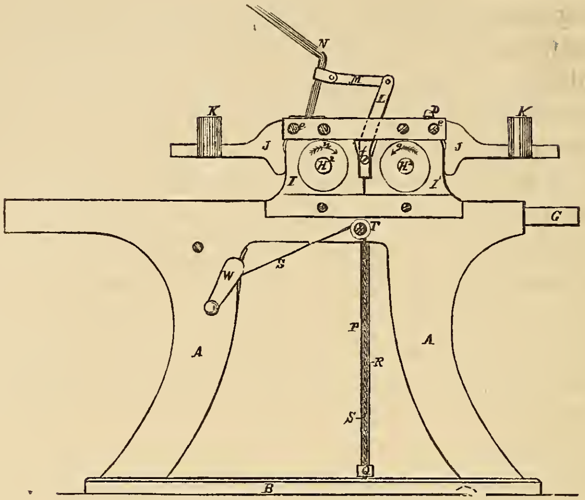


Fig. 98.

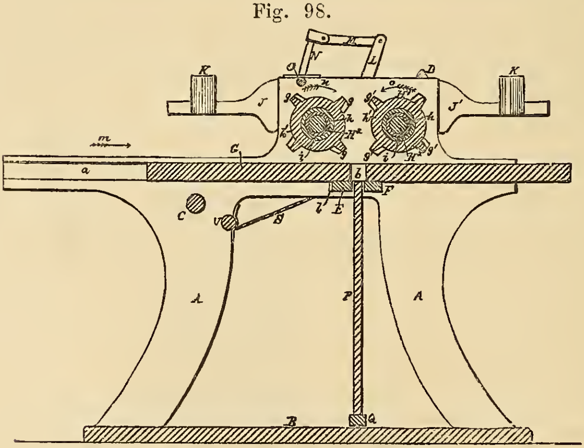
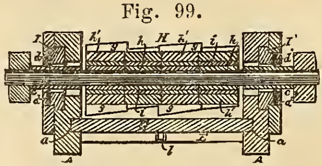


Fig. 99.



base-board *B* and the tie rods *C*, *D*, *E*, and *F*, and each having formed in its inner face a horizontal groove, *a*, into which is

fitted the table G, having in the centre of its length the slot b, extending transversely of the table, and of a length equal to the width between the frames A A.

H and H^1 are two knife-cylinders, mounted respectively in boxes c c and c' c', supported on the screw-pivots d d and d' d' set in the slides I I and I' I', which slides are fitted to and adapted to be moved horizontally in suitable ways formed in the upper portions of the frames A A.

J J and J' J' are levers, pivoted respectively to the front and rear ends of the upper portions of the frames A A at points marked e e, the short arms of these levers bearing against the outer ends of the slides I and I', while the long arms extend horizontally and carry thereon the counter-weights K K, as shown in Figs. 96, 97, and 98, which are of sufficient weight, and so adjusted that the cylinders H H^1 will be forced toward each other with enough pressure to produce the desired action upon the hide or skin as it is moved up between the cylinders.

L L are two levers, each pivoted, as at f, to one of the frames A, with its lower end between the slides I and I', and so shaped and arranged relative thereto that a movement of its top end toward the front of the machine will cause the slides I and I', and consequently the cylinders H and H^1, to be moved away from each other at about an equal rate of speed.

The upper ends of the levers L L are each connected by a link, M, to an arm or lever, N or N', formed upon or secured to the rock-shaft O, mounted in bearings formed in the frames A, as shown in Fig. 96.

The arm N is extended beyond the attachment of the link M, to form a lever or handle for operating the levers L to move the cylinders outward.

P is the carrier-plate, arranged in a vertical position, with its upper end just below the level of the under side of the table G and between the ties or guide-bars E and F, and set at its lower end in the bar Q, which has a bearing at each end upon the vertical guide-rod R, upon which it is free to be moved up and down by any suitable means for imparting a reciprocating motion thereto and to the carrier-plate P.

To each end of the bar Q is attached one end of a cord or

chain, *S*, which, after passing over the guide-pulley *T*, has its other end secured to the drum or pulley *U*, mounted upon the shaft *V*, adapted to be revolved by means of the crank *W*, or in any other well-known manner, to wind the cords or chains upon the drums, and thus move the carrier-plate upward between the cylinders H H^1, to present the surface of the hide or skin doubled over the upper edge of the carrier-plate *P* to the action of the knives or scrapers g g' upon the cylinders.

The cylinders H H^1 are made up of several short sections, placed end to end upon a shaft, each section being made up of an inner cylinder or sleeve, *h*, made of metal, and secured firmly upon the shaft H^2 in such a manner that it can neither move endwise nor revolve thereon, an outer cylinder or sleeve, h', made of metal, and provided with the blades *g* arranged obliquely upon its periphery, and an intermediate cylinder or sleeve, *i*, of rubber interposed between the two metal sleeves, the rubber being so compressed, in uniting the several parts, that the outer sleeve of each section is held from rotating about the inner sleeve by the friction of the rubber, while at the same time the rubber retains sufficient elasticity to allow of the outer sleeve yielding radially to accommodate itself to the irregularities in the surface of the hide or skin being worked.

In the under side of the table *G* is set the staple or pin *l*, in such a position relative to the slot *b* that when the table is moved under the cylinders H H^1 from the front toward the rear of the machine the staple or pin *l* comes in contact with the *T* or guide-bar *E* just when the slot *b* in the table is directly over the carrier-plate *P*, as shown in Fig. 98.

McDonald's Unhairing Machine.

McDonald's machine for unhairing and scouring hides and skins is shown in Figs. 100 to 102.

McDonald's invention has for its object the following described improvement in unhairing and scouring machines, consisting, first, in the peculiar scouring-roll employed; second, in the arrangement for effecting the release of the skin or hide from the feeding-rolls, and from between the scouring and supporting rolls, when the same may be necessary owing to the

skin or hide becoming folded in its presentation to the feed-rolls or to the scouring-rolls; third, in the organized machine, consisting in the combination of the supporting-table, feed-roll, bed, scouring and supporting rolls, arranged in relation to each other to operate substantially in the manner hereafter described in the drawings.

The operation of the machine is as follows: A hide or skin is arranged upon the table by the operator, and presented to the feed-rolls *D* D^1, and by them fed over the bed to the supporting roll *G*, which is positively actuated and revolved in the same direction as the lower feed roll, and the scouring-roll, which, preferably, is arranged immediately above the same.

The relation of the supporting-roll to the scouring-roll is regulated by means of the springs supporting its boxes and by means of the treadle *F*.

It will be observed by thus providing a yielding support or bed for the hide to be scoured, or for the skin to be unhaired, and by also providing a scouring-roll which shall possess a surface so shaped as to conform to any irregularity in the surface of the hide or skin caused by variations in its thickness, that a great improvement has been effected over the stiff arbitrary mechanism formerly employed.

Fig. 100.

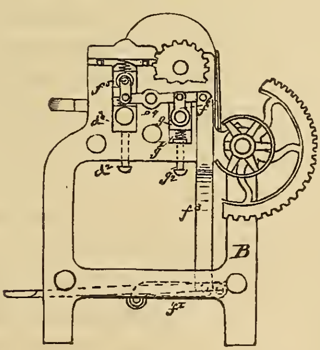


Fig. 101.

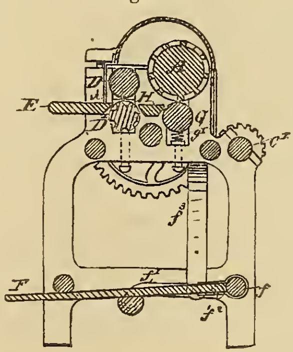
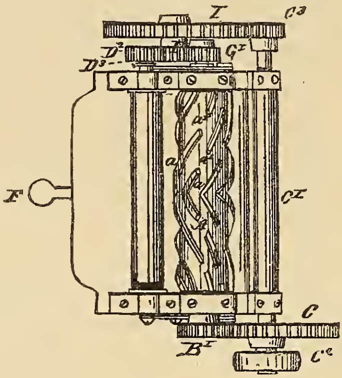


Fig. 100 is a side elevation of McDonald's machine. Fig. 101 is a central vertical section. Fig. 102 is a plan.

The scouring-roll *A* is provided with the system of spiral

projections or blades a, projecting from the circumference of the roll and conversely arranged thereon from the longitudinal centre of said circumference. These spiral projections do not extend to the edge of the roll, as in the roll in the two previous patents by the same inventor, on this machine, but are broken, as it were, at certain points, as shown at a'.

Fig. 102.



It will be observed that in shaping these projections, and in providing the roll with the system of recesses a' on the line of the spiral blades or knives, the blades are so arranged that not more than two recesses ever come in line; and it is desirable that the recesses and the projections should alternate regularly. This scouring-roll is supported upon the frame B, and is provided with the driven cog B', which is driven by the driving-cog C. The driving-cog C is fastened to the shaft C^1, which carries outside the driving-cog C the pulley C^2, and upon its other end the small driving-cog C^3.

The feed-rolls D D^1 are located in front of the table E. The upper feed-roll, D, is provided with a vertical movement in its bearings d, in which it is floated between the springs. The operator may lift the roll by means of the treadle F, which is pivoted at f, and is provided with the arms f^1, which are pivoted at f^2 to the frame of the machine, and which lay hold of the connecting bars f^3, which operate the levers f^4, pivoted to the side of the frame, as shown, and operating, through the links f^5, the

boxes carrying the feed-roll D, and, through the link f^6, upon the other end of the lever, the boxes carrying the supporting-roll G.

The machine is further provided with the bed H. The boxes g, carrying the supporting-roll G, are supported upon the springs g^1, and the degree of tension upon these springs may be adjusted by means of the set-screws g^2, which compress or relieve the springs supporting the boxes, as occasion requires, it being found in practice that in some instances it is desirable to have the boxes yield unequally, so that a hide or skin which is thicker at one end than at the other will be firmly held against the scouring-roll, while at the same time, by the increased tension of the spring, the thin portion of the head or skin is closely held against the said roll.

The feeding-rolls, together with the supporting-roll, are positively actuated by means of the gearing $I\ I'\ G'\ D^2\ D^3$. (Not shown.)

The set screws d^2 serve to lift the boxes d^3, supporting the lower feed-roll, D^1, when the same may be necessary to secure a proper adjustment of that roll in relation to the inner edge of the table and to the upper feed-roll.

McDonald's Improvement in Feed-Rolls for Unhairing Machines.

In feeding skins and hides to unhairing and scouring machines it is necessary to spread the hide or skin upon the feed-table or belt as flatly as possible, in order that all folds and wrinkles may be removed before the same is seized by the feed-rolls. It is not always possible, however, to so spread the skin or hide, and even if it is properly prepared it is of such irregular shape and varying thickness that, unless the feed-rolls act to spread as well as feed, it may become wrinkled or folded in its passage. As a consequence, the portion wrinkled or folded is not only not properly unhaired or scoured, but it is liable to interfere with the operation of the unhairing or scouring roll upon the remainder, or to be torn or a hole burned therein in its passage through the machine.

To obviate this defect the inventor employs a lower feed-roll, which is so shaped that, in connection with the upper feed-roll,

it automatically spreads the skin or hide, and at the same time requires less care in preparing the skin or hide upon the table or belt for feeding.

Fig. 103 is a perspective of McDonald's improved feed-roll, and Fig. 104 is an elevation of the same. A cross section of his machine with the feed-roll in place (like the one in Fig. 103) is shown in Fig. 101.

Fig. 103.

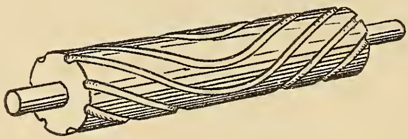


Fig. 104.

The feed-roll is provided with right and left spiral grooves. The right spirals on the one side of the centre act in opposition to the left spirals on the other side, and their combined action automatically removes wrinkles and folds, and spreads and keeps spread the material presented to them by the opposed spreading action of the conversely-arranged grooves. They are arranged upon the circumference of the roll, and extend from its longitudinal centre to the edge.

The feed-roll may be used in place of the lower feed-roll of the machine patented by McDonald, December 10, 1878, or in lieu of the lower feed-roll in the machine patented by him February 5, 1878, or instead of the feed-roll *D*, shown in the machine patented by Larrabee, and shown in Figs. 90 to 95, or in connection with any other machine, in which it is necessary to automatically spread and keep spread the material which is being passed between a pair of feed-rolls.

Of course, this roll may be provided with all the adjustments which the rolls above mentioned have in relation to the other feed-roll, and in relation to the scouring-roll.

In operation the hide or skin is seized by the two rolls, and

the upper roll pressing it upon the lower roll enables the grooves to spread the hide, the portion at the centre first laying hold of the hide, and by the continued revolution of the roll cause a separating action upon the stock from its centre toward each edge as it is being advanced, the folds or wrinkles being wiped out by the stretching action of the spiral depressions acting in opposition to each other from the centre.

Taylor's Machine for Unhairing, Fleshing, and Working Hides and Skins.

This machine which is for unhairing, fleshing, and working hides, calf-skins, pelts, and other skins in the raw or green state is shown in Figs. 105 and 106.

The invention consists in a rotary tool-stock for carrying and operating the slickers, stones, blades, or other tools necessary to effect the desired treatment of the skin, combined with a travelling carriage for holding the skin and presenting every portion of its surface to the action of the tools, the skin during its treatment overlying a bed, which is preferably supported upon springs, so as to yield to any obstructions encountered by the tools in working the hides, etc.

The operation of the machine is as follows: The tools necessary for the operation to be performed—viz., unhairing, fleshing, or working the hides, etc.—having been placed in their holders, the wheel is rotated by power or otherwise, and the hide, skin, or pelt having been placed upon the carriage, its near edge is moved over the bed *m* and there subjected to the action of the tools, the skin being progressively moved over the bed as each portion is treated until the work is completed.

The rubber face of the bed and its springs, it is claimed, render the bed sufficiently resilient to admit of the tools passing over any obstruction or extraordinary thickness in the skin without damage.

The tools are set at an angle or tangentially to the wheel's rim, in their holders, in order to better perform their necessary work.

Fig. 105.

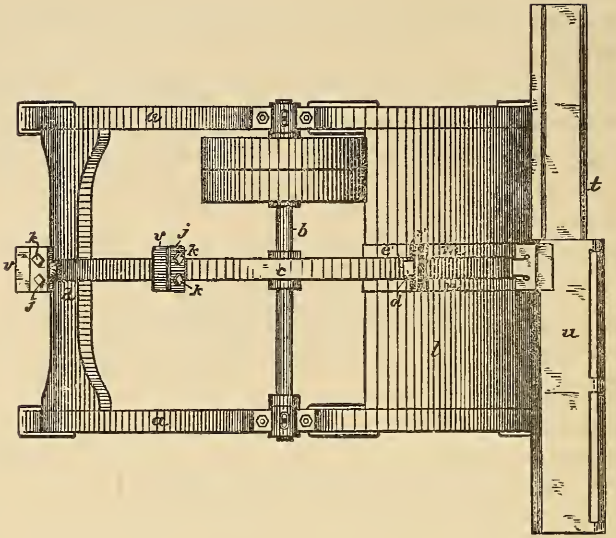


Fig. 106.

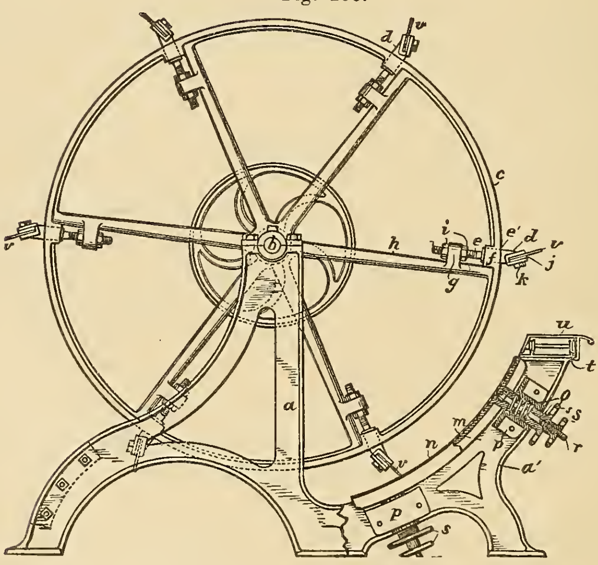


Fig. 105 is a top-plan view, and Fig. 106 a side elevation of Taylor's machine, partly in section.

In a suitable frame-work, *a*, there is mounted a shaft, *b*, having suitable power appliances. Upon this shaft is secured a wheel or tool-stock, *c*, having a number of tool clamps, *d*, arranged about its rim.

These clamps consist, in the present instance, of screw-spindles *e*, with squared heads *e′*, seated against rotation in squared holes or sockets in bosses *f* in the rim of the wheel or stock, and secured by their tails in lugs *g* on the wheel spokes or arms *h* by nuts *i*. Each spindle has its head flattened and extended laterally to receive the tool *v*—viz., slicker, stone, blade, or other implement—the tool being held and secured therein by suitable clamping devices, as a plate, *j*, and bolts or screws, *k*. The tool stock or wheel is provided with any desired or convenient number of these tool clamps or holders.

A portion of the frame *a′* is projected upwardly on the circle of the wheel, and the concavity of this projection of the frame is covered with a table, *l*. Within a slot in this table is arranged a bed, *m*, the surface of which is covered with a soft material, *n*—such as rubber cloth, felt, or other fabric—to break the force of the blow of the tools upon the skin being treated, and to prevent the breaking of the skin. In order to make this bed still more yielding, it is arranged upon springs *o*, which are confined in sockets *p* on the frame *a′*, said springs projecting out of the open ends of the sockets next adjacent the under side of the bed, and bearing thereupon with a tendency to press the bed toward the wheel. The bed is held adjustably in place by means of screw-bolts *r*, secured thereto, and passing through the sockets and retained by jam-nuts *s*, whereby also the position and resilience of the bed may be regulated.

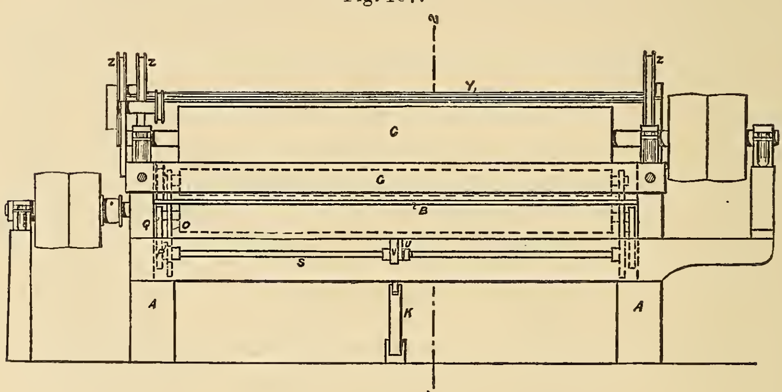
Upon the top of the projecting frame *a′*, and above the table *l*, are arranged tracks or ways *t*, which receive a travelling carriage, *u*, upon which the skin or pelt to be treated is supported, and by which such skin or pelt is moved progressively over the bed *m*, under the operation of the tools on the revolving wheel, to treat every part of the said skin or pelt. This carriage may have any suitable fastening devices for retaining a skin, and may be further provided with suitable handles or other conveniences for moving it upon its ways.

Janson's Machine for simultaneously Unhairing and Fleshing Hides or Skins.

This invention relates to improvements in machinery for unhairing, fleshing, pairing, shaving, and setting hides, skins, or pelts, by means of which both sides of a hide, skin, or pelt may be worked upon simultaneously; and it consists essentially in the use of two knife-cylinders, with their respective elastic rollers, instead of a single knife-cylinder as hitherto. The inventor claims to attain this object by the mechanism illustrated in the drawings, in which—

Figure 107 is a front elevation of the machine; Fig. 108 a left-end view of the same; Fig. 109 a transverse section on the

Fig. 107.



line 1 2, Fig. 107, showing position of lower roll when in action; and Fig. 110 a plan of the whole as seen from above.

A A are the end standards. *B* is the feeding-table; *C*, the upper knife-cylinder; *D*, elastic roll; *E*, second or under knife-cylinder; *F*, lower elastic roll; *G*, clips or draw-bar; *H*, guide-bars for same; *I*, treadle for raising roll; *K*, connecting-rod; *L*, lever; *M*, cross-shaft; *N*, counter-lever; *O*, bearing for roll *D*; *P*, counter-weight; *Q*, bearing for lower roll, *F*; *R*, rod for actuating same; *S*, cross-shaft; *T*, cranks; *U*, hand-lever; *V*, quadrant; *W*, bell-crank lever; *X*, belt for driving shaft; *Y*, cross-shaft; *Z*, rope-wheels.

It will be seen that, whereas the roll D is capable of a vertical motion, the lower or second elastic roll, F, is free to move

Fig. 108.

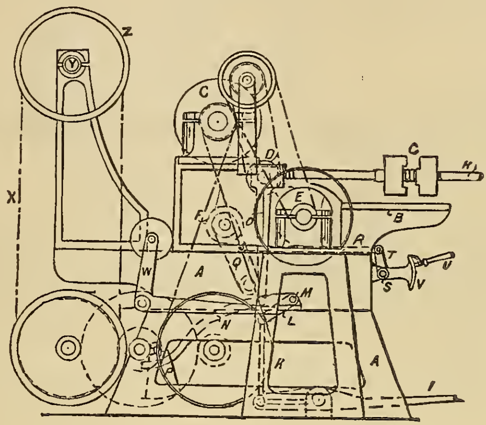
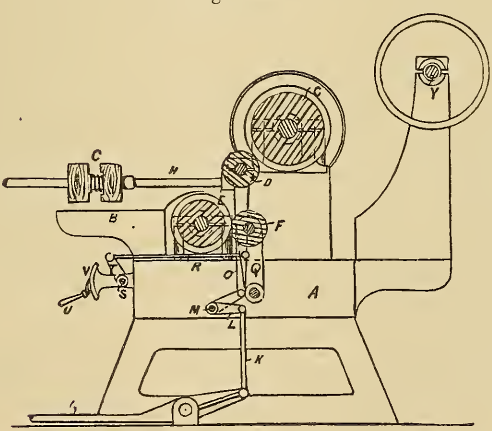


Fig. 109.

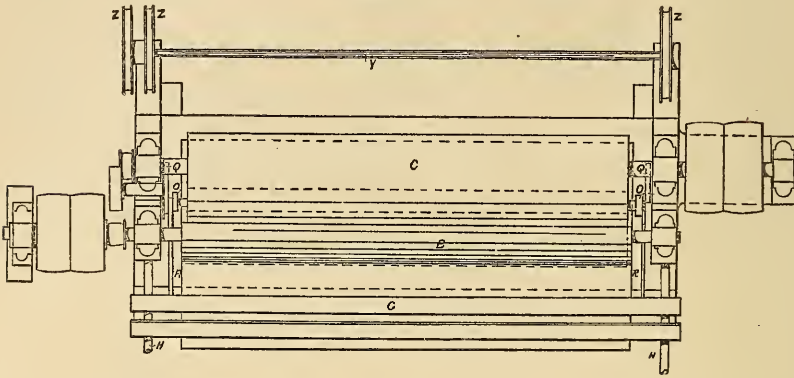


in a horizontal direction, being hung upon two arms or levers, Q Q, working upon pins secured in the end standards, A A. Two rods, R R, serve to connect these arms, Q Q, to two short levers, T T, secured upon a cross-shaft, S, arranged immediately in front of the machine. Motion is imparted to the shaft S by means of a hand-lever, U, working around a quadrant, V, as shown. By this arrangement the roll F can readily be drawn

forward, and so brought into action with the lower knife-cylinder, *E*, when required.

The draw-bar or clip *G* is connected by a rope passing around a guide-pulley secured at outer end of guide-bars *H* (not shown

Fig. 110.



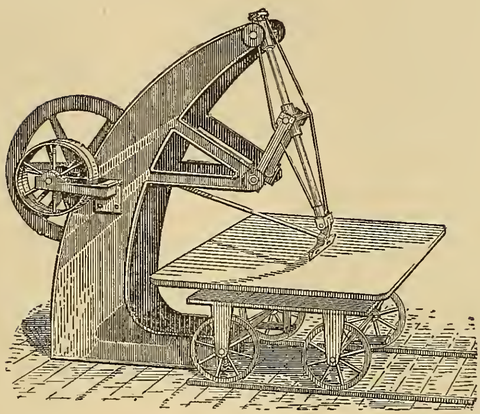
in drawings) with the rope-wheels *Z Z*, by which means it is caused to travel in an outward direction, carrying with it the skin or hide to be operated upon. The skin, hide, or pelt first presented between the top knife-cylinder, *C*, and the elastic roller *D* passes over this latter. It is then caught between the roller and the knife-cylinder *E*. The skin is then drawn out by the clips *G* in the ordinary way, and thus, passing between the two sets of cylinders and rollers, is treated simultaneously on both sides, the hair and fleshings being separated by a shield, over which the fleshings are carried.

The cylinders are furnished with knives of various kinds, according to the requirements of the particular operation to be performed upon the skin, and each cylinder will not necessarily carry at the same time the same kind of knives, as the two cylinders, while working simultaneously, may be performing different operations.

Roberts and Lenox's Fleshing, Slating, and Striking-out Machine.

The machine for the above named purposes invented by Roberts and Lenox, and improved by G. W. Baker, of Wilmington, Del., is shown in perspective in Fig. 111.

Fig. 111.



This machine requires but little power to operate it, and, when run at a moderate speed of about ninety strokes per minute, one man can it is claimed flesh or slate about six hundred goat-skins per day of ten hours.

List of all American Patents for Unhairing and Fleshing Machines.

List of all Patents for Unhairing Machines, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	July 12, 1812.	N. Kirk and S. C. Clark,	St. Clairsville, O.
	Nov. 4, 1830.	T. Williams,	Rochester, N. Y.
	Oct. 31, 1831.	T. Williams,	Rochester, N. Y.
	May 13, 1834.	J. Dunaway,	Woodville, Va.
4,570	June 13, 1846.	G. Welty,	West Newton, Pa.
20,861	July 13, 1858	J. R. Bumgarner and L. White,	Davenport, Ia.
33,229 Reissue 2,225	Sept. 10, 1861.	H. L. Arnold,	Elk Horn, Wis.
49,496	Aug. 22, 1865.	M. Bray,	Boston, Mass.
49,811	Sept. 5, 1865.	S. S. Weed,	Stoneham, Mass.
49,839	Sept. 5, 1865.	S. S. Weed,	Stoneham, Mass.
56,687	July 31, 1866.	A. Adler,	Paris, France.
60,636 Reissue 3,839	Dec. 18, 1866.	H. Lampert,	Nunda, N. Y.

No.	Date.	Inventor.	Residence.
66,124	June 25, 1867.	E. Brock,	Ellenville, N. Y.
66,176	June 25, 1867.	J. Schultz,	Ellenville, N. Y.
66,640	July 9, 1867.	J. Schiffer,	New York, N. Y.
81,247	Aug. 18, 1868.	E. Brock and J. Schultz,	Ellenville, N. Y.
89,864	May 11, 1869.	A. Hasbrouch,	Ithica, N. Y.
100,907	Mar. 15, 1870.	H. Lampert,	Rochester, N. Y.
121,565	Dec. 5, 1871.	J. Watteau,	Antwerp, Belgium.
141,972	Aug. 19, 1873.	J. Watteau,	Antwerp, Belgium.
144,150 Reissue 9,714	Oct. 28, 1873. May 17, 1881.	D. H. Sherman,	Jersey City, N. J.
184,175	Nov. 7, 1876.	T. Roberts,	Lynn, Mass.
193,412	July 24, 1877.	B. F. Larabee,	Lynn, Mass.
199,597	Jan. 22, 1878.	J. A. Tapley,	Somerville, Mass.
200,078	Feb. 5, 1878.	J. W. McDonald,	Woburn, Mass.
207,081	Aug. 13, 1878.	J. A. Tapley,	Somerville, Mass.
209,298	Oct. 22, 1878.	G. T. Sheldon,	Chelmsford, Mass.
210,797	Dec. 10, 1878.	J. W. McDonald,	Woburn, Mass.
220,930	Oct. 28, 1879.	J. W. McDonald,	Woburn, Mass.
221,545	Nov. 11, 1879.	Wm. Gerber,	Fremont Centre, Mich.
224,286	Feb. 10, 1880.	A. Gerard,	Soigneies, Belgium.
227,974	May 25, 1880.	Wm. Gerber,	Fremont Centre, Mich.
234,542	Nov. 16, 1880.	J. Curson,	Lyons, France.
239,841	Apr. 5, 1881.	A. W. Reid,	Schenectady, N. Y.
241,073	May 3, 1881.	C. Schultz,	Milwaukee, Wis.
241,171	May 10, 1881.	E. D. Warren,	Woburn, Mass.
249,114	Nov. 11, 1881.	C. H. Taylor,	Woburn, Mass.
256,326	Apr. 11, 1882.	J. M. Jones,	Wexham, North Wales.
257,495	May 9, 1882.	J. W. Janson,	London, England.
262,520	Aug. 8, 1882.	E. D. Warren,	Woburn, Mass.
280,698	July 3, 1883.	A. E. Whiting,	Winchester, Mass.

List of all Patents for Fleshing[1] *Machines, issued by the Government of the United States of America, from* 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence
239	June 17, 1837.	R. Shailer,	Haddam, Conn.
4,712	Aug. 26, 1864.	A. Smith,	Cumberland Valley, Pa.
59,692	Nov. 13, 1866.	J. S. Wheat,	South Wheeling, W. Va.
109,379	Nov. 22, 1870.	J. M. Brown,	Boston, Mass.
170,855	Dec. 7, 1875.	Wm. H. Holmes,	Philadelphia, Pa.
192,479	June 26, 1877.	T. W. Appleyard and W. L. Appleyard,	Hunslet Carr, England.

[1] See also in the list of Unhairing Machine patents, Nos. 4,570, 20,861, 33,229, 56,687, 66,640, 89,864, 221,545, 224,286, 239,841, 241,073, 249,114, 256,326, 257,495.

No.	Date.	Inventor.	Residence.
198,941	Jan. 8, 1878.	E. B. Holcob, and D. A. Clay,	Port Leyden, N. Y.
212,555	Feb. 25, 1879.	H. A. House,	Bridgeport, Conn.
239,522	Mar. 29, 1881.	J. W. McDonald,	Woburn, Mass.
247,648	Sept. 27, 1881.	H. A. House and S. D. Castle.	Bridgeport, Conn.
265,293	Oct. 3, 1882.	A. Whiting,	Rochester, N. Y.
275,305	Apr. 3, 1883.		

NOTE.—The illustrations of fleshing knives in this chapter are from the catalogue of Messrs. Wm. H. Horn & Bro., Philadelphia, Pa., who are the leading manufacturers in America of tanners' and curriers' tools; their goods being not only largely consumed in this country, but also exported to Russia and other portions of Europe as well as to South America.

CHAPTER XVII.

BATING.

BATING AND FINAL PREPARATION FOR THE OOZE—BATING COMPOUNDS—LIST OF AMERICAN PATENTS FOR BATING COMPOUNDS.

SECTION I. BATING AND FINAL PREPARATION FOR THE OOZE.

THE operation of immersing hides and skins intended for the manufacture of upper, Morocco, and other pliable leathers, in an alkaline solution consisting of the dung of chickens, pigeons, dogs, or in bran water, or in any of the compounds intended to supersede the dung solutions, or to be used in combination with them, is termed either "bating," "abating," "grainering," "drenching," or "puring." The bate is used in the manufacture of soft and pliable leathers after the hides are taken from the "limes" and have been "unhaired" and "fleshed," and before they enter the "handlers," which is the first stage of the actual tanning process.

The period which the hides or skins remain in the bating solution is dependent upon the temperature of the bate and the

thickness of the material subjected to its action. The object of bating is to allow the solution to penetrate the hide and neutralize the lime in the pores.

The dung of chickens is the material usually employed for bating upper leather, while dogs' dung is used for Morocco leather, and the bate for sheep-skins is usually prepared from bran-water.

The theory of dung bating, while obscure, is that a chemical combination is formed with the lime under the influence of the agents of which the droppings are composed, the ammoniacal chloride parting with its chlorine to form the chloride of lime, which is readily dissolved in water.

Hydrochloric acid possesses the property of dissolving lime in the manner accomplished by the bate, as was shown by MacBride in 1774.

Carbonate of ammonia was employed by Warrington in 1841, for accomplishing the purposes of the bate.

Sugar was used by Trumbull in 1847, in the proportion of four or five pounds of cane-sugar or molasses to seventy gallons of water, and this solution, it was claimed by him, formed a soluble saccharate of lime.

In addition to the substances named, carbolic acid, sulphuric acid, dilute phosphoric acid, organic acid, muriate of ammonia, alum, etc., are now also employed.

Some of the objections to the present method of bating in addition to its expensiveness are:—

1. The disagreeable odor and uncleanliness attendant upon the use of the excrement of animals.

2. The difficulty in obtaining properly skilled labor to superintend the operation, which is necessary because of the tendency to decomposition produced by the use of animal excrements. This decomposition is designated by tanners generally as "running away," and means literally that the skins are frequently decomposed into a state of liquid putridity, and only skilled tanners by watching the vats can detect the approach of such a condition.

3. Then there is such great difference in the strength of the same kind of animal excrements, as that of dogs for instance (due

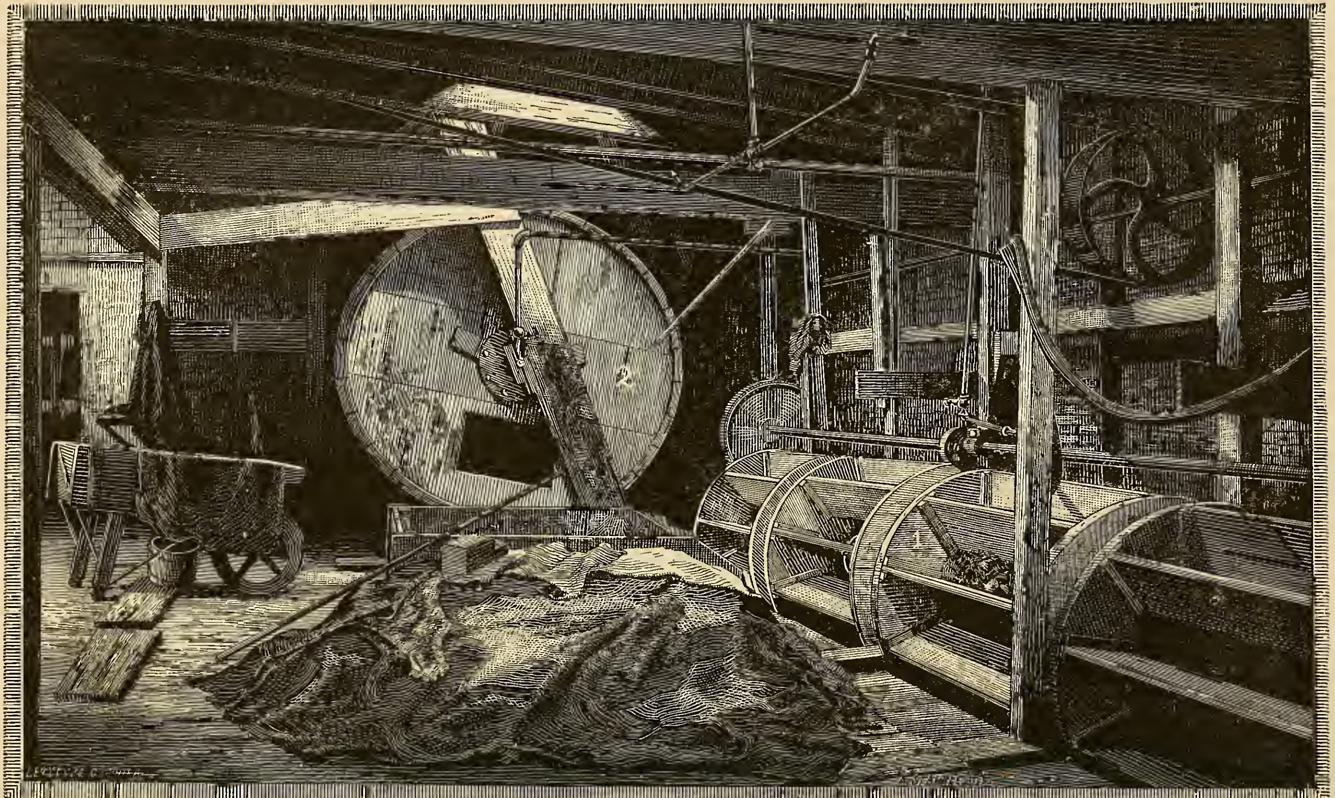


Fig. 112. Vats and Wheels for Bating and Washing. Page 337.

to the different varieties of food upon which they have been fed, vegetables, bones, etc.), that practically no definite period can be positively set within which it is safe to let the excrement operate.

4. The influence which the electrical condition of the atmosphere has upon stock in the bate, which is frequently damaged or spoiled during thunder-storms.

The bating is usually accomplished by placing the hides or skins in a vat having a circular and tight bottom, over which vat is arranged a revolving paddle wheel, marked 1 in Fig. 112, which dips into the solution contained in the vat, thereby agitating it and maintaining the sides or skins in constant motion, thus hastening the work of bating and greatly lessening the time and the danger of spoiling the material in the bate.

After the sides or skins have been properly treated they are placed in the interior of the wheel or drum, marked 2 in Fig. 112, and washed with clear water for a few minutes.

The English wheels used for agitating the bate liquor, and the wheel used for washing the sides or skins are shown in perspective view in Fig. 112.

When the sides show the right condition scouring is proceeded with, this operation being effected either by hand or by a hide-working machine such as is shown in Figs. 114 and 115, or the scouring may be performed by the McDonald, the Larrabee, and other machines shown in Section IV., Chapter XVI., at the time of unhairing, if such latter operation be performed by machinery.

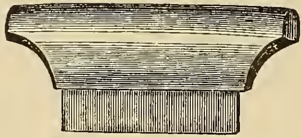
The object of this scouring, which should not be confounded with the scouring which is to be hereafter described for removing the bloom from the hides after tanning, is to free the hides from lime and dirt and fit them for the reception of the tannin ooze to which they are to be first subjected in the handlers.

In the preparation of sole leather the hides are scraped on the grain side with a curved knife, in order to cleanse them from lime remaining in the pores after the last soaking, and this operation is termed "graining."

The hand process of scouring upper leather is effected with a tool called a scouring slicker, consisting of a steel blade fixed in a stock or handle, the blade being sharpened by grinding it per-

pendicularly and then on either side, thus producing two edges or rather right angles. This tool is shown in Fig. 113.

Fig. 113.



Six to ten hides having been spread over a broad beam the slicker is applied stroke after stroke, but not too vigorously, and any fleece hairs which may be found are removed with a sharp knife. If during this operation the ground becomes readily detached so that it runs down perceptibly, the hides have acquired a sufficient degree of softness.

Final Soaking before placing the Hides in the Ooze.

After treating the hides in the above manner, and being assured by the previously described tests that they have been sufficiently soaked, it is only necessary to replace them in water for 12 hours longer. The safest indication of the hides being ready for the ooze is that, when passing the fingers over them, strokes remain as indentations. For the final soaking of sides intended for upper leather spring water is usually employed.

Lampert's Apparatus for Working Hides.

The machine shown in Figs. 114 and 115 is the invention of Lampert, and, in addition to unhairing and fleshing hides, it is also much used in working out the lime and dirt after bating.

Fig. 114 is a side elevation of Lampert's invention. Fig. 115 is a transverse section at the dotted line x, Fig. 114.

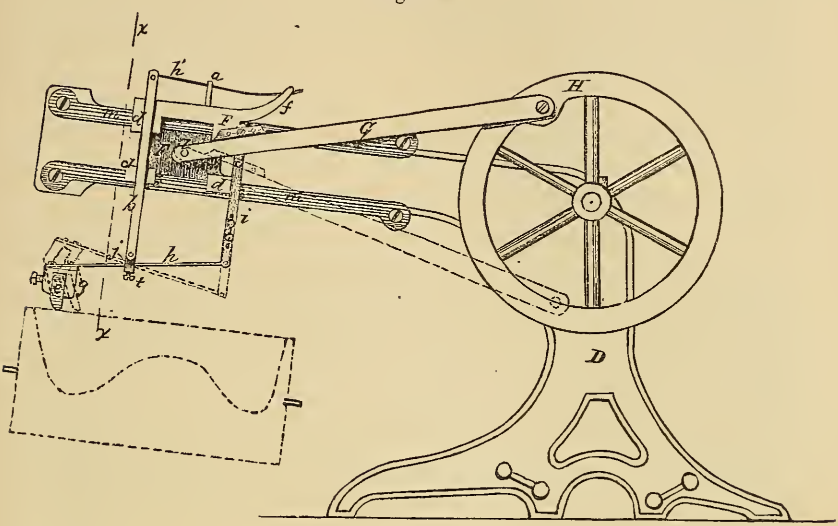
The cross-head F and worker g are operated by the pitman G and driving-crank H.

The slides m are arranged in a vertical line upon the side of the frame D, and the cross-head moves between them, as shown.

Lugs d, upon the cross-head, embrace the slides and retain the former in place.

The worker g, provided with a knife or scraper, e, is suitably secured to the spring bar h, which passes through a slot in the

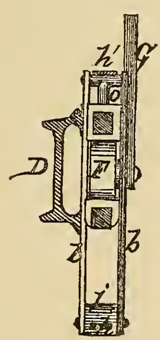
Fig. 114.



block j, pivoted to the lower end of the suspenders b, Figs. 114 and 115.

These suspenders slide in grooves formed in the lugs d, upon each side of the cross-head, and extend a short distance above the latter, where they are connected together by the stud o, Fig 115.

Fig. 115.



The spring, h', rests at one end upon the stud o, or upon the end of the suspenders, and at the other upon a horn, f, projecting from the cross-head.

This spring is retained at a certain degree of tension by a staple, a, secured to the cross-head and embracing the spring at or near its centre, thus causing the worker to bear upon the beam (shown in dotted lines in Fig. 114) or upon the hide placed thereon.

By this arrangement a pressure is obtained not only upon the worker independently of the bar h and its adjustments, but

also, since the elasticity of the former is divided between the bar h and spring h', the worker is retained more squarely upon its work.

The inner end of the bar h is jointed to the link i, and connected by it to the pitman G at a suitable point between the cross-head and crank.

The link i is made adjustable in its length by means of set-screws sliding in slots, or by other equivalent device, whereby the worker g is adjusted vertically, and consequently the tension of the spring bar h varied.

It will be observed that by the action of the pitman G the worker g is lifted from the hide during the forward stroke, and depressed upon it during the backward stroke, by means of the pivoted spring-bar h and link i, as indicated by dotted lines in Fig. 114. A stop upon the stud o, Fig. 115, prevents the suspenders and worker from descending too far.

A still further vertical adjustment of the worker may be had, if necessary, in case of the wearing away of the knife or scraper, by inserting the bar h in either of two or more slots formed in the block j, Fig. 115.

In working the flesh side of the hide it is often necessary to use a knife or stone, set at such an angle as to cut or separate the fibre of the fleshy material. For this purpose the upper face of the worker g is somewhat inclined where it is attached to the bar h, whereby the tool e acts as a scraper, as shown in dotted lines in Fig. 114.

When, however, the worker is reversed horizontally, as indicated by dotted lines, the tool assumes a sharper angle with the work, and acts as a knife. The worker is secured to the bar h in a convenient manner for removal.

Provision is made for longitudinally adjusting the pivoting point of the link i upon the pitman, by which the amount of lift of the worker and the exact point of its ascent and descent is determined.

The pivoting-point of the bar h to the suspenders b is made horizontally adjustable by means of the set-screw t in the block j, thus varying the amount of lift of the worker in proportion

to the throw of the crank H, and also the tension of the springs h and h'.

Hides are easily handled upon this machine, the drum, shown in dotted lines, revolves, allowing the hide to move sideways with but slight effort, and as the parts are finished the hide is drawn towards the operator.

Section II. Bating Compounds.

Bating with Muriate of Ammonia either alone or in combination with Hen's, Pigeon's, or Dog's Dung.

This bate was patented by Zollickoffer in 1838, and was used very successfully by him for a long period. He used the muriate of ammonia as a bate for all kinds of hides and skins, either alone or in combination with either hen's, pigeon's, or dog's dung, and he states that he bated hides and skins in a much shorter time than is required by using either of the last-mentioned substances alone. When he used muriate of ammonia alone, he took seven pounds, which he reduced to a coarse powder, and upon which he poured ten gallons of hot water, in order to facilitate its solution. This solution he would throw into a vat containing a sufficient quantity of clean water to cover five hundred pounds of hides or skins, dry weight, in a state of preparation for the bate. Into the bate thus prepared the last-named quantity of hides or skins was thrown. All kinds of skins were bated in one hour, horse hides in two hours, and ox hides and other thick hides in three hours. The ox and other hides he handled once during their continuance in the bate, in one hour after they were placed in it, and when the muriate of ammonia was used in combination with either hen's, pigeon's, or dog's dung he took two and one-half pounds of muriate of ammonia, dissolved in four gallons of hot water, after having previously reduced the ammonia to a coarse powder. This solution he would throw into a vat containing the quantity of either hen's, pigeon's, or dog's dung bate necessary for bating five hundred pounds of hides or skins, dry weight.

Into this bate was thrown the quantity of hides or skins in

the usual state of preparation for undergoing the process, taking the precaution, however, previously to place them in a pool of clear water for five minutes to wash off the adhering dirt and lime.

By this last process all kinds of skins were bated in three hours, horse-hides in six hours, and ox-hides and other thick hides in nine hours.

The last-mentioned hides Mr. Zollickoffer would handle three times, the end of the second, fourth, and sixth hour after they were submitted to the bate.

Horse-hides were handled twice, the end of the second and fourth hours; and all skins were handled once, the end of the first hour.

The hides and skins which were bated by this process were reduced and softened analogous to those bated with either hen's, pigeon's, or dog's dung alone, and the hairs, dirt, and lime worked out with equal ease.

After they are bated by this process they are to be treated like all other hides and skins bated in the usual way.

In 1842 Zollickoffer patented another composition for bating hides by using in combination the muriate of soda, super-tartrate of potassa, and tartaric acid. The manner of preparing it is as follows: Take two pounds of the muriate of soda, one pound of super-tartrate of potassa, and one-half pound of tartaric acid, all of which throw together into a suitable vessel and upon which pour five gallons of boiling water, and as soon as they are dissolved throw the solution while hot into a clean vat containing a sufficient quantity of clear water to cover five hundred pounds of hides or skins already unhaired, fleshed, and washed in clean water, then agitate the fluid so as to mix the water and the dissolved composition thoroughly together, and into this throw the prepared hides or skins.

Skins smaller than calf-skins are removed in less than one-half hour and stoned and beamed, calf-skins in one-half hour, horse-hides in one hour, and ox-hides in one and one-half hours, and placed upon a heap, and after they are stoned returned to the bate again, where they are to remain the same length of

time as before. Upon the completion of the last period the hides are to be worked over the beam.

With this bate hides and skins need not be handled if they are put into it in a workmanlike manner; but before they go into the bark they are to be washed off in clean water, and will then be prepared for the action of the tannin.

If the hides and skins cannot be conveniently worked out of this bate in forty-eight hours they will not sustain the least injury, as this process is a preventive of the putrefactive condition by which hides and skins often become destroyed by the bate in common use.

With this bate it is claimed that hides and skins are reduced and softened in a superior manner, and the operator is enabled to work out the hair, dirt, and lime with great ease. The grain side, gelatine, and general texture not being impaired, and the leather prepared after its operation is equally flexible, more compact and ponderous than that prepared after the bates in common use, which act upon the principle of putrefaction.

Bating with a compound of Carbolic Acid, Muriate of Ammonia, and Alum.

Parkins, the inventor of this compound, explains its action on hides and skins, which have been depilated by lime, as follows:—

The lime remaining in the hide or skin after all mechanical means have been employed (such as repeated washing, rinsing, scraping, soaking, etc., for its removal), does not amount to a large percentage, still there is sufficient lime left to form with the tannin an insoluble compound, which retards the progress of tanning by closing the pores and preventing the tan-liquid from penetrating the interior of the hides or skins, aside from which leather containing this tannate of lime is often harsh and brittle.

The bating solution which Parkins employs is composed of, say three-fourths of a pound of carbolic acid, six pounds of muriate of ammonia (sal ammoniac), and six pounds of alum dissolved in one hundred and fifty gallons of water; but these proportions may be varied to conform to the experience of those who use this compound.

When hides or skins are immersed in this liquid (after being freed from the lime by mechanical means) for twenty-four hours or longer, it is claimed that all the remaining lime is entirely removed, and the pores of the hides or skins opened so as to make them absorb the tannin more rapidly and thoroughly, and therefore making a plumper and softer leather.

Hides and skins having been treated with lime should be worked in this improved bate precisely as in any other; and as regards the length of time they are to remain in the bate, this will depend on the thickness and other conditions of the pack; but practical tanners will know when the hides are bated sufficiently; and in order to make the bate penetrate uniformly, they are worked on the beam once or twice during the bating.

Bating with a Mixture of Sulphuric Acid with the Lime Liquor in which the Skins have been already treated for removing the Hair.

This composition is the invention of Vickers and Holmes, and the object is an economical and effective solution for bating skins, consisting of a mixture of sulphuric acid with the lime-liquor in which the skins have been already treated for removing the hair.

After the skins have been depilated in the usual manner by treating the same with lime, the patentees take the resulting lime-liquor and dilute it with warm water, and then add sulphuric acid until the liquor accords in strength with the character of the skins to be acted on.

This solution is used for bating the skins in place of the usual solution of dog and pigeon manure, which, aside from its uncleanliness, has a tendency to rot the skins, whereas it is claimed that this solution, in which the skins are permitted to remain from one to ten hours, breaks up the gristle, opens the pores, and loosens the animal matter from the skins, so that it can readily be worked out, and at the same time toughens the skins and renders them easier to tan and firmer after being tanned.

Bating with Bran, Oil of Vitriol, and Salt.

Stack has invented a new and improved process for bating and cleansing hides, of which the following is a description.

In a vat six feet by four feet, and six feet deep, containing about three feet of water, put three bushels of bran, three pints of oil vitriol, and one peck of salt, and the same proportions for vats of different sizes. In this vat put a batch or pack of sixty sides or two hundred skins. This bates the hides, it is claimed, in from eight to forty-eight hours, according to age—say twenty-four hours for calf, goat, and sheep, and forty-eight hours for harness and upper leather. When the bate is old, eight or nine hours, it is claimed, will do for skins, and twenty-four hours for sides, upper, and harness leather; but the time will be regulated mainly by the judgment of the tanner.

For a second pack, one bushel of bran, one pint of vitriol, and two quarts of salt will do; and for a third pack, half a bushel of bran, one pint of vitriol, and two quarts of salt will be required.

To prepare the bate, put three bushels of bran in a barrel, cover it about three inches with water, and let it stand seven or eight days before putting it in the vat.

For a new bate, always keep a little bran and water in a barrel ready for use; and after the third pailful or two of bran and water for every pack, add one pint of vitriol and one pint or quart of salt, according as the bate is strong or weak. In a new bait, "handle up" the hides three times the first day and twice the second.

In another vat, commonly the one called the pool, with sufficient water to cover the hides, put in a half-barrel of tar-water and soda, in the proportion of two-thirds of a barrel of water, one pailful of coal-tar and one pound of bicarbonate of soda, and wash and cleanse the hides in it after they have remained a sufficient length of time in the bate, which completes the process, and makes the hides ready for the tan-liquors.

When the bate gets old, put into it half a barrel of tar-water. It acts as a check on it, and keeps the smell down.

To make a very fine quality of calf or kip, work the skins lightly on a beam out of this mixture in the pool.

This process it is claimed makes the leather from five to ten per cent. heavier than the common process.

Bating with Glucose and dried Sour Cheese.

The object which McMurtrie had in view in the invention of this bate was to form a compound which, when complete, would be in condition convenient for packing, storage, and transportation, and be always ready for use in any quantity. This he claims to have accomplished by thoroughly incorporating with dry pulverized glucose, or its equivalent, a suitable proportion, about ten per cent., of dried sour cheese or its equivalent, forming a compound which may be packed, transported, and stored, without danger of deterioration, and which when added to the vats containing the skins impregnated with lime, will, it is claimed, undergo molecular transformation with production of lactic acid.

The acid thus formed, combining with the lime, makes a soluble compound, which may be removed by washing with water, or the ordinary treatment of the skins.

Instead of glucose, starch, dextrine, cane-sugar or other amylaceous or saccharine substances suitable for making a portable compound may be substituted; and for cheese gluten in any form, or albumen, from whatever source it may be obtained in a dry condition, it is claimed may be used.

These have, however, the disadvantages of being either more costly, and of being more tardy in their action, and glucose and cheese are, it is claimed, therefore preferable. In case of either of these substances being used, the compound formed should be well dried before packing.

Bating with a Liquor composed of Water impregnated with Sulphur Dioxide that has previously been employed in soaking and softening Hides.

The object of this invention is to cleanse and purify hides and skins from lime and humus, and also to remove the epidermis when desirable, and any hairs remaining from the depila-

tion after liming. In practice the inventor, Maynard, discovered that he could utilize the "soak," which is a liquor composed of water impregnated with sulphur dioxide that has previously been employed in soaking and softening the skins in preparing them for the liming operation. This results, it is claimed, in a great saving of expense, and besides avoids the disagreeable odor attendant upon the use of excrement of animals, which is at present generally employed. The soak, after the softened hides have been removed, contains sulphur, phosphorus, and carbon, with traces of nitrogen, in combination with hydrogen, because in the soaking operation the skins have absorbed oxygen while the elements above described have been eliminated from the skins and remain in the bath. All these in combination are efficient, and especially the phosphorus and hydrogen, in the cleansing and puring process. It has been found that this solution sometimes lacks sufficient ammonia for the purpose of cleansing rapidly, and also that the lime requires something with which it can enter more rapidly into combination, and which will also render it soluble. The inventor, therefore, occasionally employs chloride of ammonium, and sometimes sugar in small quantities, while he has found argols to assist the effect produced by the soak, and to be a very useful, and in some cases necessary, adjunct. The inventor claims to have found that the use of argols and chloride of ammonium, singly or in combination, is non-effective without the soak, inasmuch as while the lime has been eliminated the skin itself has not been left in that absolutely necessary state of reduction and softness technically known to tanners and readily distinguished by them as "pured." This imperfect state or condition of the skin Maynard claims to have obviated by the use of the soak, either alone or in combination with small quantities of chloride of ammonium or argols, or both.

The inventor claims to have found that in puring he could more or less successfully use the following as substitutes for the chloride of ammonium and argols, viz: sugar, hydrochloric acid, chloride of potassium, and caseine; but recommends the chloride of ammonium and argols as preferable.

Instead of using the soak, as above set forth, it is, of course,

possible to manufacture sulphuretted hydrogen, or even the hydrogen compounds of carbon and phosphorus; but this expensive course need not be resorted to, because the soak is always at hand and available without cost, after it has served its ordinary purpose in the soaking operation.

By the use of this invention, it is claimed to be practicable to calculate, by knowing the strength of the "bate," which is easily obtained, the period of time in which the bating or puring can be safely and thoroughly performed. This period will, in practice, vary somewhat, according to the nature of the skins and the electrical condition of the atmosphere; but ordinarily it is claimed that in about one-fifth the usual time necessary where animal excrement is employed the puring will be satisfactorily completed. Different hides being of varying age and toughness are more or less sensitive to the action of lime; therefore a greater or less quantity of lime has to be used, and it necessarily follows that the bate also should be of variable degrees of strength. Maynard states that he has found in practice that the strength of the liquid, when chloride of ammonium is used, should vary from one-half pound to one pound per hundred gallons of the soak, according to the thickness, age, and toughness of the hides and skins to be treated. Although this rule is a guide, it is not arbitrary, because much depends upon the number of skins to be treated in a given quantity of liquid, but these facts or elements being all such as can be known by a competent superintendent in advance, it is quite easy for him to calculate the short period of time that will be required for the bating operation. It is to be understood that the liquid should be agitated from time to time and the skins moved in the same during this bating process.

By this invention it is claimed that all the requirements are fulfilled at less expense and without the disgusting odor, the danger of decomposition by the formation of too much ammonium, or the action of phosphuretted gases upon the skin, attendant upon the use of excrement, while the removal of the lime is also claimed to be certain and the action upon the epidermis perfect, without the possibility of damage. Furthermore, the chief agent by which these desirable results are

brought about is a product of the tannery itself, which has hitherto been deemed worthless.

Mullen's Process.

This process consists in drenching in a liquor composed of soft soap and sal-soda dissolved in water, in about the following proportions: For one hundred sides, about 3 quarts of soft soap and one pound of sal-soda, dissolved in a sufficient quantity of water to cover the sides. After being properly softened the sides are left in the solution four or five days, then unhaired and afterwards placed in a fresh solution for twelve hours, after which it is claimed they are ready for the tan-liquor.

Adamson's Process.

This method consists in bating hides and skins in dilute phosphoric acid, precisely as the ordinary mixtures are used for the same purpose.

NOTE.—Vast quantities of dilute phosphoric acid are formed in glue factories, by treating with muriatic or sulphuric acid and water bones and horn-piths, for the conversion of the same into glue-stock. The residuum after this treatment is dilute phosphoric acid, which is largely permitted to run to waste as an article of no commercial value.

Söderberg's Process.

In this process the bate consists of water, chloride of soda, and dissolved sulphur, mixed in the following proportions: about 400 gallons of water, to which are added about 10 pounds of chloride of soda, and 10 pounds of dissolved sulphur, in which the hides are treated for about two days.

The dissolved sulphur is obtained by boiling 10 pounds of sulphur, with about 12 gallons of water and about 5 pounds of common soda.

The object of the chloride of soda is to open the pores of the hides or skins, so that the sulphur can act upon them more quickly for the purpose of removing the lime.

Wilson's Process.

This process consists in treating hides and skins to a solution, for the purpose of bating them after they have been subjected to the action of lime for removing the hair.

NOTE.—This bate is composed as follows: Wheat or ground barley, 2 bushels; chloride of sodium or common salt, 50 pounds; sulphate of magnesia or Epsom salts, 3 pounds; sulphuric acid, 3 pounds; the ingredients being thoroughly mixed with 5 or 6 barrels of water, or sufficient water to cover when in the tank about 150 hides.

If the liquor be not agitated the hides or skins remain in the solution about 36 hours; but if agitated by a revolving wheel, such as is shown in Fig. 112, then it is claimed that about 5 hours will be sufficient for the action of the solution.

Wells's Process.

This process consists in bating with a strong solution of salt and water.

Tucker's Process.

This bate is compounded as follows:—

Water	20 gallons.
Wheat-bran	1 bushel.
Starch	4 pounds.
Hen manure	1 peck.
Muriatic acid	1 pound.
Buttermilk	1 gallon.

Stir the mixture well before the hides are immersed in it, and handle several times daily until freed from lime.

Swan's Process.

This process consists in subjecting limed hides to the action of an aqueous solution of alum, whereby it is claimed that the lime is removed, by combining with the alum in solution and leaving the hide forming an insoluble precipitate that falls to the bottom of the vat in which the hides are bated.

NOTE.—The alum bath consists of 2 ounces, avoirdupois, of alum to 1 gallon of water.

Turley's Process.

This process of bating and tanning hides, consists in first subjecting the same to the combined action of carbonic and sulphurous acid gases, and then partially tanning and afterwards subjecting the partially tanned hides to the action of said combined gases, and finally tanning in the usual manner.

List of all Patents for Compounds for Bating[1] *Hides and Skins, issued by the Government of the United States of America, from* 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
592	Feb. 3, 1838.	Wm. Zollickoffer,	Middleburg, Md.
2,332	Nov. 10, 1841.	S. Guilford,	Lebanon, Pa.
2,756	Aug. 18, 1842.	Wm. Zollickoffer,	Middleburg, Md.
5,261	Aug. 28, 1847.	Dr. A. Turnbull,	London, England.
8,500	Nov. 4, 1851.	W. B. Milligan,	Edinburgh, Va.
35,293	May 20, 1862.	J. Brainard,	Cleveland, O.
38,267	April 21, 1863.	R. Wagner,	Lancaster, Pa.
59,627	Nov. 16, 1866.	J. M. Mullen,	North Becket, Mass.
79,177	June 23, 1868.	Wm. Adamson,	Philadelphia. Pa.
86,506	Feb. 2, 1869.	L. Clozel,	Grenoble, France.
87,202	Feb. 23, 1869.	L. F. Robertson,	Morrisania, N. Y.
99,387	Feb. 1, 1870.	G. W. Adler,	Philadelphia, Pa.
109,656	Nov. 29, 1870.	C. F. Paukin,	Charleston, S. C.
110,161	Dec. 13, 1870.	L. F. Robertson,	New York, N. Y.
144,328	Nov. 4, 1873.	M. W. Fry,	Guyandotte, W. Va.
146,789	Jan. 27, 1874.	J. Vickers and H. Holmes.	Philadelphia, Pa.
152,187	June 16, 1874.	Wm. Slack,	Sussex, Canada.
153,636	July 28, 1874.	C. J. Tinnerholm,	Quincy, Ill.
158,608	Jan. 12, 1875.	C. J. Tinnerholm,	Keokuk, Ia.
181,621	Aug. 29, 1876.	A. W. Barnes and W. F. Yocum.	Weston, Mo.
184,114	Nov. 7, 1876.	M. J. Söderberg,	Malmo, Sweden.
189,536	Jan. 2, 1877.	N. Wilson,	Becket, Mass.
194,090	Aug. 14, 1877.	R. Hein,	St. Mary's, Pa.
197,739	Dec. 4, 1877.	Wm. McMurtrie,	Oxford Township, Warren Co., N. Y.
223,200	Dec. 30, 1879.	I. Wells,	Wilmington, N. C.
229,928	July 30, 1880.	T. P. Tucker,	Independence Co., Ark.
237,630	Feb. 8, 1881.	J. S. Swan,	Mongaup Valley, N. Y.
249,540	Nov. 15, 1881.	Wm. Maynard,	New York, N. Y.
262,516	Aug. 8, 1882.	M. Turley,	Council Bluffs, Ia.

[1] See also patents, Nos. 76,824, 104,719, 135,214, 196,672, 221,187, 254,962, and 262,924 in Tanning Processes, etc.

PART V.

CHAPTER XVIII.

HANDLING AND PLUMPING.

SECTION I. HANDLING.

THE occasional removal of hides or sides from the vat, and then replacing them, also the agitation of the stock at stated times while remaining in the liquor in the vat, is termed "handling," the object of which is to equalize the action of the lime in the unhairing process, the bate in the bating process, and of the weak liquor or ooze in the first stage of tanning.

The old manner of handling hides like most of the primitive methods of the tanner's art was exceedingly slow as well as laborious; but of late years numerous appliances have been perfected for mechanically performing this work by means of which the stock is handled with great facility and at the expenditure of but little labor. One old method was to haul up the sides by hand from the vat and pile them, and in this condition, allow them to press and drain, and then after a sufficient time throw them again into the vat.

Another and later method was to "shift" or change the sides from one vat, over into another by means of hooks.

Handling and transferring the sides by the medium of a revolving device, such as the hand reel, is an old-fashioned method which has not yet become obsolete; but which continues to be employed in the majority of both small and large tanneries in this country.

This manner of handling seems to be both convenient and economical, and as there are but few objections that can be urged against it, there are at present but slight chances of it being generally abandoned for later processes, of which we have a great variety.

There are two modes in vogue of connecting the sides, which are to be handled, with the reel. One is to tie them together with strings and the other is to connect them with a tie-loop; but the first method is most commonly employed, and is the least expensive.

The hand-reel is about three feet high and is made as light as possible, consistent with requisite strength, in order that it may be readily moved by two men from one vat to another.

When in use the reel is placed intermediately on the alleys between the two vats in which the hides are to be handled and the sides or hides are drawn over the drum by the workman who turns the crank attached to the shaft on which the drum is fastened. Two men are required to operate this reel, one to adjust the sides or hides in the head vat, and the other to work the crank.

Another form of handler in use is known as the rocker handler, and it consists of a frame constructed of wood, and hung by pivots in the centre of the top of the vat so as to give a dipping movement of 7 or 8 in. to each end of the frame, and the sides are hung over sticks placed across the frame from the two sides, motion being usually imparted to the handler from shafting placed overhead.

The apparatus shown in Figs. 116 and 117 was invented by L. C. England, in 1871, and consists in a good method of keeping the stock suspended in the liquor so that all parts may be brought into constant contact with the ooze, and its employment in liming, bating, and handling should produce a smooth grain and good quality of leather.

Fig. 116 is a perspective view of the apparatus, showing it removed from the vat. Fig. 117 is a vertical section of the same showing it applied to a tan-vat.

The frame F is made to conform to the interior of the vat, and consists of the upper and lower rails, S, S^1, S^2, and S^3, and the cross rails E, E^1, E^2, and E^3, which are joined together by means of the uprights U, U^1, U^2, U^3, and U^4, and which uprights serve as guides to retain the frame in a horizontal position.

The frame F is also provided near the lower part with two diagonal braces, B, B^1, at the point of intersection of which is

an upright shaft, *R*, to which power is applied to operate the frame, the braces serving to agitate the liquors.

The series of bars *d d d*, are held by the binders *T*, T^1 which prevent them from shifting as the frame moves downward.

Fig. 116.

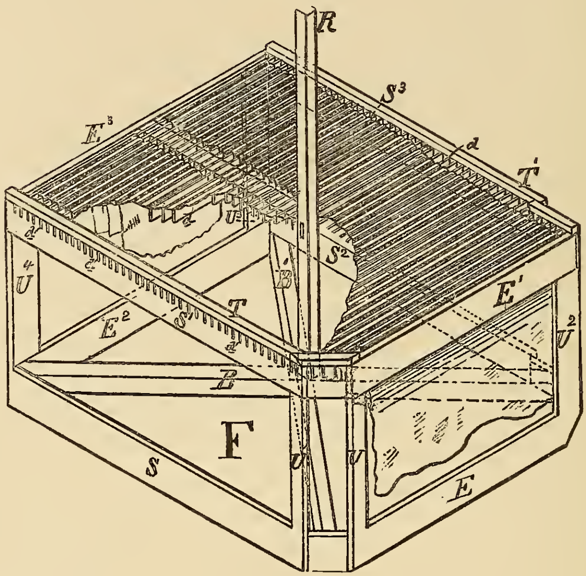
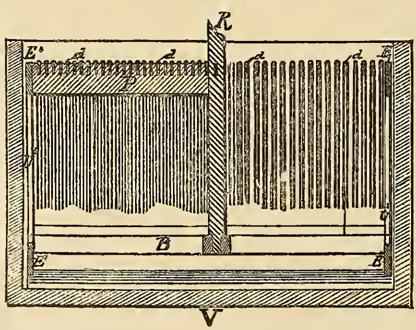


Fig. 117.



The stock is hung on the movable bars *d d d* with head and butt down, and the proper liquors supplied.

The frame is placed in the vat so that the top of the stock resting on the bars may be about eight or ten inches, more or less, below the surface of the liquors.

The whole frame is then caused to move upward in a vertical line of a few inches, four to six being sufficient, but should not be allowed to raise the stock above the surface of the liquor. The stock being loose on the bars will, when the frame moves downward, be left suspended in the liquor, entirely free from contact with the bars, thus allowing the liquor free access to the parts of the stock, which, when the frame is at rest, adheres to the bars on which it is placed. The upward and downward vertical motion given to the frame will keep the stock at nearly the highest point at which it is raised by the first stroke of the frame upward, the frame being moved faster than the stock would sink in the liquor if unobstructed. Every returning upward stroke of the frame will carry the stock back to the highest point again. The frame is caused to move only so fast as will have the desired effect, and at intervals, as occasions may suggest.

The specific gravity of the frame and stock being very small, the power required to give the necessary motion while they are submerged in the liquor is correspondingly small.

The paddle-wheels for handling shown in Chapter XVII., Fig. 112, which were also invented by L. C. England, in 1847, are largely employed in handling heavy, medium, and light leathers.

These wheels work within three-quarters of an inch of the sides and are usually five and a half feet in diameter, and have eleven paddles about seven-eighths of an inch thick, and spaced equidistant apart, which is about eighteen inches between centres at the outer edge.

The vats in which the wheels revolve have the bottom concave to conform to the convexity of the wheels which are placed over the centre of the vats, so that the wheels dip about eight inches in the liquor, and thereby cause a gentle but thorough agitation of the ooze and stock, which moves in an opposite direction from that of the wheels.

The motion of the wheels causes the stock to move up in front, pass under the wheels, and down on the concave bottom to the

back of the vat, and thus by means of the paddles, and the constant changing position of the stock a thorough and gentle agitation is maintained. But if the bottom of the vat should be made square, the agitation would be too great to answer the purpose.

No fixed length of time can be set for running these wheels, as the period depends upon the stock being handled; light sides, as those used for upper leather, being handled for a shorter period and not so often as the heavy whole hides employed for making enamelled and patent leathers.

The wheel for no class of leather should be run at a greater speed than eighteen revolutions to the minute, and the motion should be steady and regular. Cog-gearing is best, and possesses a great advantage over belting, as the latter, from the slow motion required, often becomes troublesome.

Wheels of this kind are generally arranged in a line, as shown in Fig. 112, and sometimes so constructed that any one of them can be thrown out of gear, by means of a clutch connected with the loose pinion on the shaft.

It has at times been tried to apply these wheels to quicken the after-process of tanning; but while they answer for light leathers, it is the opinion of some who have experimented with them upon heavy leathers that they will not answer; but notwithstanding this opinion, I have seen them successfully employed at Newark, N. J., and other places, for tanning heavy whole hides to be used in the manufacture of enamelled leather.

This wheel furnishes a most simple and effectual mode of moving the incipient leather in the liquor, and does away entirely with the necessity of handling by hand, facilitates the after-process of tanning, economizes in labor, forms a handsome grain, and in all respects improves the quality and texture of the leather.

Methods of handling, such as lacing it together and drawing the stock through rollers, or placing the hides, sides, or skins upon a web, unlaced and feeding the stock to the rollers, are not now employed in this country. However, they continue to be profitably used for some classes of leathers by a few European tanners, the theory being that by pressing the liquor out of the

pores in handling that, upon re-immersion, the liquor into which the stock is placed acts more quickly and in the end produces a heavier weight than is ordinarily obtained.

In the manufacture of pebble and grain leathers the sides are tacked upon sticks and handled into stronger liquor about every three days, and it might here be stated that any method of handling which allows both the grain and flesh sides to be uniformly exposed to the action of the liquor will fill all the requirements, provided there is a gentle agitation of the fibre at occasional periods.

In some portions of the country the handling is performed by placing the stock in the interior of a large revolving drum about 10 feet in diameter, one half of which turns in the liquor of the vat, the centre shaft upon which the drum is supported turning in bearings resting upon the top of the vat.

The interiors of these drums are best divided into three or four compartments, as it is easier upon the green stock than allowing it to be treated in an unpartitioned wheel, and besides the operation of the contrivance is facilitated by retaining a portion of the contents near the centre.

In Gorsline's apparatus for handling, the sides or skins are placed in the vat resting upon five straps, having cross slats attached to them, and one end of each of the straps is attached to the top of the vat, and when it is desired to raise the pack, the centre strap is wound around a drum which gradually raises it, and as it approaches the top the operator standing upon the alley can easily seize the hides and throw them out.

The slats slide over the centre strap which winds upon the drum, thus preventing them from striking the frame and stopping the machine.

In raising the pack the inclined position it assumes has a tendency to wash off the sediment or bloom, presenting the same advantage in this respect as in handling by hook in the ordinary way.

This contrivance is better adapted for handling kips and skins than for heavy sides or hides.

Steinmann's apparatus for handling hides in the lime-pits is shown in Figs. 74 to 77. Study's contrivance for liming hides has been described on page 269.

List of all Patents for Tanners' Vats, Agitators, and Handling Appliances, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	Jan. 9, 1834.	S. Stem and D. Wireman.	Mechanicstown, Md.
795	June 20, 1838.	W. L. J. C. Rouse and S. Tabor.	Wade's Post Office, Va.
1,906	Dec. 17, 1840.	W. Buchannan,	Milford, Pa.
2,552	April 11, 1842.	J. Southwick,	Boston, Mass.
2,729	July 20, 1842.	W. Wallace and J. Fleming.	Lehman, Pa.
2,868	Dec. 5, 1842.	D. H. Mason,	Dahlonega, Ga.
4,851	Nov. 14, 1846.	A. H. Breschermann,	New York, N. Y.
6,340	April 17, 1849.	T. W. Brown,	Howardsville, Va.
7,854	Dec. 24, 1850.	L. C. England,	Williamsburgh, N. Y.
8,500	Nov. 4, 1851.	W. B. Milligan,	Edinburgh, Va.
12,369	Feb. 6, 1855.	L. W. Fiske,	Louisville, Ky.
14,135	Jan. 22, 1856.	D. H. Kennedy,	Reading, Pa.
15,844	Oct. 7, 1856.	E. A. Eliason,	Georgetown, D. C.
20,093	April 27, 1858.	D. Philbrick,	Manchester, N. H.
23,053	Feb. 22, 1859.	C. Weston,	Salem, Mass.
33,203	Sept. 3, 1861.	W. P. Martin,	Salem, Mass.
33,448	Oct. 8, 1861.	S. J. Patterson,	Bridgeport, Conn.
33,645	Nov. 5, 1861,	D. A. Havaland and S. A. Phillips,	Fort Dodge, Ind.
39,824	Sept. 8, 1863.	B. B. Mereness,	Georgetown, N. Y.
41,336	Jan. 19, 1864.	J. S. Wheat,	Berkley Springs, Va
48,758	July 4, 1865.	W. H. Study, S. J. Miller and A. B. Barnett.	Economy, Ind.
59,469	Nov. 6, 1866.	J. Snell, Jr.,	Pottsville, Pa.
68,861	Sept. 17, 1867.	L. C. England,	Philadelphia, Pa.
70,306	Oct. 29, 1867.	J. C. Williams,	Philadelphia, Pa.
80,947	Aug. 11, 1868.	J. Hammond,	Lattsburgh, Ohio.
91,402	June 15, 1869.	H. W. Adams,	Philadelphia, Pa.
116,626	July 4, 1871.	T. K. Parsons, Chas. E. Getchel, and S. W. Fairfield.	Salem, Mass.
116,766	July 4, 1871.	N. Smith,	McAllisterville, Pa.
122,157	Dec. 26, 1871.	J. W. Coburn,	East Walpole, Mass
123,192	Jan. 30, 1872.	D. F. Noyes,	Lewiston, Me.
135,231	Jan. 28, 1873.	C. H. Manning,	Washington, D. C.
Reissue 8,639	Mar. 15, 1879.		
138,906	May 13, 1873.		

No.	Date.	Inventor.	Residence.
150,657	May 5, 1874.	S. H. Hall,	Belle Plaine, Iowa.
163,021	May 11, 1875.	C. H. Manning,	Washington, D. C.
165,212	July 6, 1875.	W. Coupe,	South Attleborough, Mass.
170,330	Nov. 23, 1875.		
Reissue		O. W. Bean,	Tecumseh, Mich.
7,311	Sept. 19, 1876.		
182,198	Sept. 12, 1876.	J. J. Johnston,	Columbiana, O.
182,614	Sept. 26, 1876.	J. R. Teass,	St. Albans, W. Va.
197,426	Nov. 20, 1877.	C. Steinmann and J. Mitzger.	Cincinnati, O.
199,534	Jan. 22, 1878.	J. T. Gorsline,	Parma, N. Y.
205,596	July 2, 1878.	A. Whiting and J. A. Smith.	Rochester, N. Y.
211,063	Dec. 17, 1878.	C. Steinmann,	Cincinnati, O.
214,220	April 8, 1879.	A. Whiting,	Rochester, N. Y.
214,439	April 15, 1879.	A. Palmer,	Rochester, N. Y.
219,537	Sept. 9, 1879.	J. A. Smith,	Rochester, N. Y.
240,988	May 3, 1881.	C. Flohr,	Canisteo, N. Y.
276,634	May 1, 1883.	G. Ruemelin,	Milwaukee, Wis.
278,331	May 29, 1883.	D. Halsey, Jr.	Newark, N. J.
281,061	July 10, 1883.	J. Head,	Richmond, Va.

Section II. Swelling or Plumping.

The swelling or "plumping" follows the unhairing and fleshing, and after the bating of the hides, which has been described, and it consists of a more or less prolonged immersion in an acid liquor which is gradually increased in strength. Its essential action consists in completing the swelling of the cells, distending the pores, and thus favoring the absorption of the tannin. A secondary action takes place ; it is a commencement of tanning due to the presence of a certain quantity of tannin in the liquor; the swelling being due to the action of the acetic acid and of the lactic acid of the hide. Both acids are products of decomposition and oxidation of the tannin.

Some wood vinegar may be added to the sour tan liquor in order to accelerate the swelling. This process does not cause any damage to the quality of the leather; but some tanners replace the acetic acid by sulphuric acid, which, at an equal degree of acidity, costs considerably less. This practice is prejudicial to the quality of the leather. It is true that the

swelling is satisfactorily produced, and the leather looks well, but, prepared in this manner, it retains traces of sulphuric acid which corrode it internally after a time, and make it very brittle and more subject to alteration by moisture, and there are other defects which will be mentioned shortly.

The "plumping" process is applied to the heavier classes of hides only, such as those employed for the manufacture of sole-leather, upper-leather, etc.

Plumping by Means of Sour Liquor.

There are at present two methods in common use by which this plumping is accomplished, as has been stated. In one of these the tanning-liquor which has been in use for some time is made use of under the name of "tailings," or sour liquor, and in which the hide having been properly prepared is first placed.

The fresh tan-liquors after a short time become changed in their character and nature, and the resultant is a liquid in which we find tannic, gallic, and acetic acids in varying proportions, combined with decaying vegetable and putrescent animal matter, but the presence of the latter substances seriously interferes with the exhibition of those active principles which the tanner seeks to utilize from his sour liquors, and it is the presence of this decomposed matter that forms the only objection to this method of plumping hides, and which gives it the principal danger, which, while not great, still requires watchfulness.

The second method of plumping, and which will be enlarged upon in the next section of this chapter, is to steep the hides in a cold, dilute, sulphuric-acid liquor.

But while the latter method expedites the work, it has the effect of rendering the leather harsh, liable to be brittle, and gives a dark grain to the same, it being conceded by all practical tanners that the process in which the plumping is wrought by the presence of the acetic or aceto-gallic acid principle in the tailings is far preferable, could the same be divested of the trouble arising from the decaying animal and vegetable substances present in all tanning-liquors which have been used for any length of time.

H. J. Botchford, of Leyden, N. Y., proposes to remedy this by

subjecting the sour liquors to a distillation in a still suitably constructed, by which the acetic and gallic acids are recovered in a pure form, freed from the other substances of the liquors. The distillate thus resulting is now taken, and, in a properly dilute form, is again used as a liquid in which the plumping of the hides may be very expeditiously and satisfactorily accomplished.

In the practical working of this process the distillation is best accomplished by the use of a still in which the liquors from which the acid products are to be recovered are heated by means of a steam-worm coiled within the body of the retort containing the said liquors, the vapors of the acids thus liberated being conducted from the head of the retort through a tubular condenser, the temperature of which is maintained at a sufficiently low point for the proper condensation of the acid vapors by surrounding the same with water at a low degree of heat; but any apparatus ordinarily termed a "still" will answer, as long as its materials are arranged to be proof against the attack of the acids to be recovered, and the heat of which can be maintained equally.

Plumping by means of Sulphuric Acid.

In 1773, David MacBride, a physician of Dublin, introduced the employment of sulphuric acid for swelling or plumping hides, and though it may appear strange that such an improvement should have been made by a member of the medical profession, still this, like many other advances, was the result of accident, which arose from a series of experiments carried on for purely medical purposes, for confirming a theory that an infusion of malt would cure the sea scurvy.

MacBride for four years kept the matter a partial secret, imparting the knowledge to only one firm of tanners in the city of Dublin; but on May 31, 1777, after being at liberty to disclose it he did so in a communication to the Royal Society, and it is recorded among the Philosophical Transactions.

Vitriol or sulphuric acid, as it is also termed, is used for plumping both lime and sweat stock. The coloring and plumping of the latter are usually accomplished simultaneously in the

handlers, the liquor being strengthened after the removal of each pack.

But while vitriol can be employed without danger on limed stock, it is desirable to observe caution in employing it upon sweat stock in order that it may not be too much swelled, as its action is more energetic upon hides which have been subjected to the sweating process.

Some tanners find that it is an improvement to treat sweated hides to a weak lime bath, especially when they are to be plumped by sulphuric acid.

The acid is diluted with cold water, and sometimes more or less of the old sour tan liquors are employed in conjunction with the sulphuric acid in order to hasten the process of preparing the hides for the tanning proper.

It is, of course, impossible to give the exact proportion of vitriol to be employed in every case; but the quantity now used is about the same as that prescribed by MacBride, more than a century ago, viz., to use his own language, "a wine pint of the strong spirit of vitriol is sufficient for fifty gallons of water to prepare the souring at first; therefore, all you have to do in raising sole leather, is only to prepare it beforehand in the usual way, and when it is fitted for the souring, mix up a quantity of vitriol and water, according to the number of hides that you require to have raised, still observing the proportion of a pint to fifty gallons, which will be enough if the vitriol be of the due degree of strength. The hides may lie in the souring till you find them sufficiently raised, for they will be in no danger of rotting, as they would be in the common sourings, which in time might turn putrid and rot the leather, whereas the vitriolic liquid keeps off putrefaction."

In the early use of sulphuric acid by our tanners, an almost general lack of knowledge of the nature and effect of the substance under certain conditions was largely prevalent, and much harm resulted from its injudicious employment in the handlers, but while practical experience has done much to aid the tanner in obviating disastrous results, there is still much desirable knowledge regarding its use in tanning that can result only from chemical experiments.

The most concentrated sulphuric acid is a definite combination of forty parts sulphuric oxide and nine parts of water, the formulas representing it being H_2O, So_3, or H_2So_4, and is a colorless oily liquid having a specific gravity of about 1.85, of intensely acid taste and reaction.

Oil of vitriol has a most energetic attraction for water, it withdraws aqueous vapor from the air, and when it is diluted with water great heat is evolved, so that the mixture requires to be made with a little caution.

The specific gravity of sulphuric acid being so much greater than tan-liquor, it has at all times a strong tendency to settle and mark with spots of different colors the grain of the pack, and it is only by strict watchfulness that this can be avoided, and when vitriol is added to the pack, it should be done before the sides are thrown in, and the plunging should be faithfully performed in order to prevent the discoloring of the grain by the settling of the acid. The swelling or "plumping" process is, for the reasons previously stated on page 167, accelerated, and the falling back of the hides into their previous state prevented by the use of hard water.

CHAPTER XIX.

LAYING-AWAY.

The hides having been raised, the texture dilated, and therefore weakened, and being deprived of that natural gum which absorbs moisture, are in a condition to be tanned, that is, to have their fibres strengthened and re-united.

Tannin is, therefore, an astringent and impregnating substance, by the agency of which the fibres maintain their independence and the faculty, as it were, of sliding one upon another in their moist state, and by the means of which, also, the dried leather is rendered manageable and elastic.

Without tannin the skin becomes horny as it dries, and loses all elasticity and malleability, which is due to the fact that the

bunches of interwoven and compact fibrous cellular tissue, of which it is composed, stick together, and constitute then a continuous, semi-transparent mass.

Leather is probably not, as has been heretofore considered, a chemical combination of the animal substance with the tanning substance; for the reason that the latter is never absorbed in equal proportions, but in variable quantities, according to the concentration of the liquid and the nature of the dissolvent. "One may even obtain leather by the sole use of fatty substances, for which there can be no question of a chemical combination with the animal tissue. Mr. Knapp has even succeeded in tanning or making leather without tanning elements. Starting from this principle that the filaments adhere or stick together only when they are swollen by water, he has put the hide in contact with such a liquid as alcohol or ether, which, expelling the water by endosmosis, deprives the fibres of their faculty of sticking. He has obtained in this way a tawed skin, of a nice white, and having all the physical qualities of tawed hides. The same result is obtained by suspending a cleansed skin in anhydrous ether placed above a layer of chloride of calcium. The water with which it is impregnated diffuses itself in the ether and is gradually absorbed by the chloride of calcium. Any leather thus prepared—the only difference in which from the moist hide, dried and horny, consists in the physical state of the fibres which have kept their independence—becomes an ordinary skin, with all its qualities, as soon as it is moistened.

"It results from these interesting experiments that tanning is based rather on a physical action than on a chemical reaction. The tanning substances, penetrating the hide by endosmosis, envelop the fibres, adhere on their surface through an attraction similar to that which causes the precipitation of coloring matters on the surface of textile fibres. The fibres thus surrounded by a layer of foreign matter do not adhere any more in drying.

"The faculty which the tanning substances possess besides, of rendering the leather imputrescible, is independent of their physical action. It may disclose itself more or less energetically, according to the more or less antiseptic nature of the compound used.

"A very interesting experiment of Knapp shows besides that one may compare the leathers, as regards the solidity of the tanning with dyed tissues, some of which are of good tint and others of false tint.

"Thus the hides tanned with tan-bark resist the action of water, while those prepared with the tannin of the gall-nut come back to the state of untanned hide, after a prolonged wash with carbonate of soda, which proves that the active substance of tan is not entirely identical with gallotannic acid."[1]

Following this theoretic discussion we shall now proceed with the final step in the process of tanning heavy hides and skins, such as are employed for sole and upper leathers, etc., which is the laying-away of the stock. The usual size of the lay-away vats for sole leather hides is nine feet long, seven feet wide and six feet deep, and in these the stock is usually placed with the grain side up in order to avoid "hook marks" in removing them.

Fig. 118.

Fig. 118 shows the manner in which the stock is laid away, it being spread out smoothly and upon the bottom of the tan-vat, and between each layer there is sprinkled a slight thickness

[1] Wurtz. Dictionnaire de Chimie, Pure et Appliquée, iii., 193 *et. seq.*

of ground bark until the vat is filled by the stock and bark thus laid in *stratum super stratum.*

Tan-liquor is then run into the vat, and when the interstices are filled the whole is crowned with a layer of bark which tanners call a "heading."

Formerly the inter-laying layers of bark were depended upon to do the tanning; but at the present time in this country the bark-liquor is relied upon and not the interlaying bark. In European countries the layers of ground bark are still generally depended upon to do the tanning, and the time is consequently longer than with us.

In the early stages the green stock requires more attention than when it is nearly tanned, as at first it absorbs the tannin very rapidly and then gradually its capacity for absorption grows less until at the finish it refuses further to imbibe the tannic acid, and, as has been stated on page 129, the skins do not absorb an unlimited quantity of tannin, and are probably not improved by remaining a long time in the vat.

The number of layers and the period of each differ for the various leathers, and depend upon the substance and weight of the stock, the strength of the liquors to which it is subjected, the season of the year and various other appendant matters; but it is not uncommon in this country to tan the heaviest sole-leather in four layers of the following periods, the liquors at the end of each stage being of the indicated degrees of strength, which gradually increase from say 6° at the start, to about 30° at the finish:—

1st layer,	12 days	16°
2d "	18 "	20°
3d "	24 "	25°
4th "	36 "	30°

Making the whole period ninety days, and in some cases it has been accomplished in much less time.

In order to obtain full weight and brighter color the time of the final layer is prolonged, for when insufficient time is allowed to this layer there will be lack of solidity and the grains will be inferior.

In the manufacture of finer grades, such as oak-tanned

sole leather of the kind which is used for the soles of ladies' and children's shoes, the packs are generally laid-away five times. New liquors, or mixtures of new and old, are preferable for dry hides, old liquors for slaughtered. When laid-away in bark the packs are changed, as has been stated, until tanned. Much care and judgment are necessary in proportioning the continually increasing strength of the liquors to the requirements of the leather in the different stages of the process. The liquors should also be kept as cool as possible, within certain limits, and ought never to exceed a temperature of 80° F. Too high a heat, with a liquor strongly charged with the tanning principle, is injurious to the life and color of the leather, and the use of a too weak one must also be avoided. Hides treated with liquors below the proper strength become relaxed in their texture and lose a portion of their gelatine. The leather loses in weight, and is much more porous. The greatest strength of liquor used for handling should not exceed 16° by the barkometer; and that employed in laying-away should mark at its greatest strength from 30 to 35°.

It is the custom, when the liquors in the lay-away vats are gradually increased in strength, to remove the packs after the stock has laid-away long enough, and run the ooze through wooden pipes into a receiver, and from thence to pump the liquor back to the leaches where it passes through the bark and is restrengthened, and then run as new liquor into the vats.

Another method is to allow the fresh and strongest liquor direct from the leaches to pass first upon the head packs of the last layer, and from thence to the next, and so on through all the layers, and of course decreasing in strength and becoming more acid until finally it passes upon the first lay-aways, or into the handlers where it is exhausted.

When this method is employed the liquors when they come from the leaches should be at least 30° and ought not to exceed 35° in strength; but the liquor should never in the end be allowed to remain upon the stock after its strength is spent.

When heat is used on the head leaches the liquor sometimes enters the lay-away yard in a hot condition, and the intent is of course to turn it into the head lay-away; but sometimes the attendant by mistake allows it to run on the green stock, thereby

causing damage to the leather, as the "black rot" will be certain to set in to a greater or less extent, especially in the heated season of the year.

In tanning heavy upper leather the practice among some of our best tanners is to first handle the sides on sticks for ten or twelve days, and then lay them away twice in bark both lay-aways generally extending over a period of about sixty days, the first lay-away being for about twelve days and the second for about forty-eight days. After this the sides are split and then, after being levelled off, the sides, twenty-five at one time, are placed in a large revolving wheel and worked for about ten minutes with moderately strong gambier liquor. From thence the sides go again into the handlers, but this time without sticks, and are drawn each day for about fifteen days. This completes the tanning of the upper leather, and it is then ready for the scouring and finishing.

CHAPTER XX.

SPLITTING LEATHER.

After the sides have been removed from the lay-away vats they are—in the manufacture of upper leather and some other varieties of leather—hung on poles in the yard of the tannery to harden, and then carried to the cellar and dampened preparatory to being split. For other, and more minute details in relation to splitting leather the reader is referred to the chapters treating of the manufacture of upper and buffed leather.

Fig. 119 shows an interior perspective view of the cellar of an upper-leather tannery. Piles of sides that have been dampened, and in condition to be split are shown at 1 and 4. The three splitting machines in a line, marked 2, are known as the Union-Splitting Machines; the one in the background marked 3, is the Belt-Knife Machine. The manner in which power is supplied

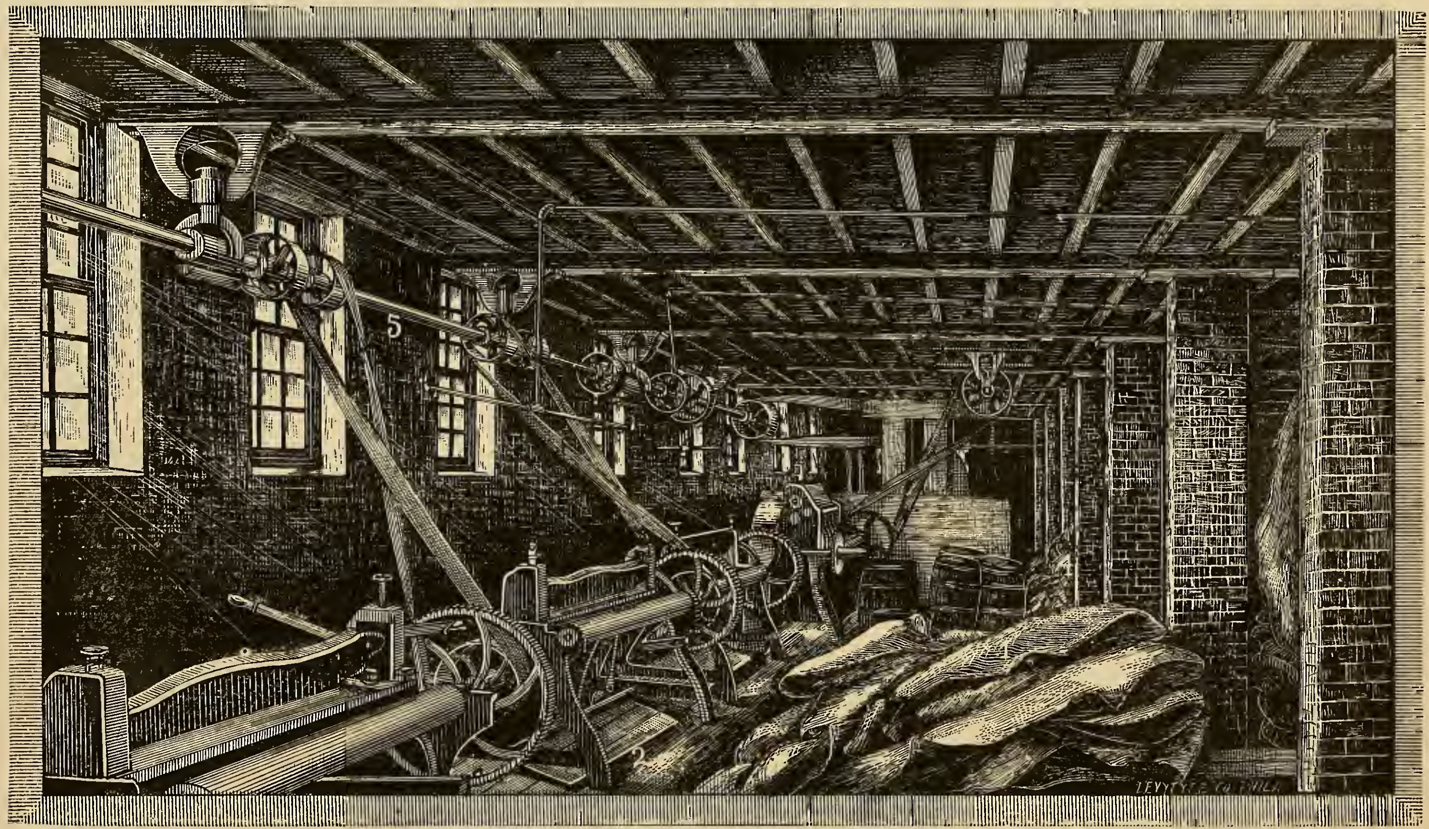


Fig. 119. The Cellar of an Upper-leather Tannery. Page 368.

to the machines by means of a line-shaft is shown, the line-shaft being marked 5.

For those who are building or equipping tanneries, views of this kind contain many valuable suggestions, as those in this work were taken under the author's personal supervision from the most modern and concededly the best arranged tanneries in the United States. The view shown in Fig. 119 is from the tannery of Mr. Thomas E. Proctor, Peabody, Mass.

Splitting Machines.

Early in 1831 Alpha Richardson, of Boston, Mass., patented his first splitting machine for leather.

Seth Boyden, of Newark, N. J., had nearly a quarter of a century previous to this invented a machine for this purpose; but while a large number of machines of this character had come into use there were numerous objections to them which it remained for Richardson to overcome.

He gave great attention to the perfection of his contrivance, and continued to improve it until 1856, when he combined all his patents in the "Union Splitting Machine," which is now in such general use.

Since the successful introduction of splitting machines hides have been split to meet all required conditions, and they may be split either in a green or tanned condition.

In the manufacture of heavy upper leather, as is fully explained in the chapter on that subject, the sides are split after being only partially tanned.

When it is desired to split whole hides, as in the manufacture of enamelled leather for carriage tops, etc., a machine constructed on a different principle is employed. The one in most common use for this purpose is known as the "Belt-Knife Splitting Machine," which was invented in 1854 by Joseph F. Flanders and Jere A. Marden of Newburyport, Mass., and which machine is now manufactured by The American Tool and Machine Co., Boston, Mass.

The facilities afforded by machines of the character that have been mentioned, allow good "grain splits" to be obtained, which are used very largely for shoes, and also for harness, trunks,

etc., and the large production of buffed and grain leathers, which are now so much used in this country, and form an important item in our export list, has been greatly aided by them.

Fig. 120.

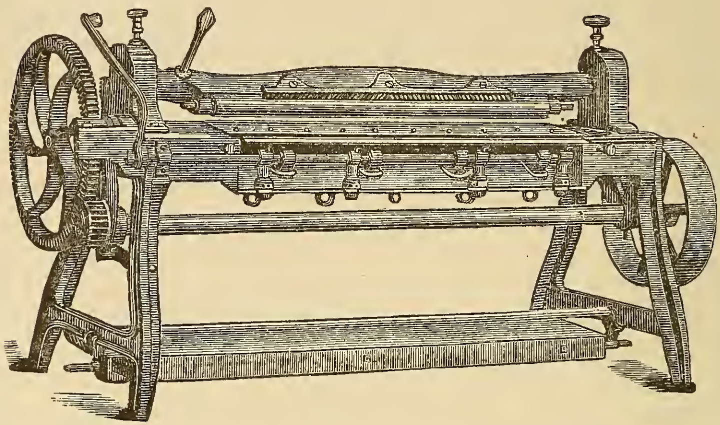


Fig. 121.

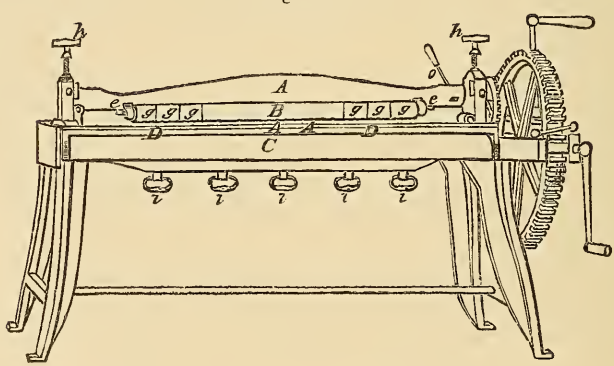


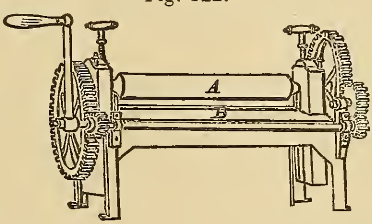
Fig. 120 shows a perspective view of the A. Richardson or Union Splitting Machine, geared so as to be run by steam power, and Fig. 121 is a perspective view of the hand power machine, and the operation of splitting the side of leather is the same in both cases.

The leather to be split, after having been properly dampened, is drawn between the knife and roller. In Fig. 121 *A* is the

cast-iron piece connected with the gauge-roller *B*, which revolves on the centres *e e*, and is turned up by the lever *o*, to allow the placing of the leather upon the top of the knife and back-spring *A A*. The skin being in right position, the gauge is then turned back, and forms the gauge for the thickness of the skins which may be regulated at will, by means of the screws *h h*. *B* is the roller with the sectional tubes *g g g*, which are arranged to turn on its end, and to serve as friction-rollers when the shanks and loose parts of the skin are being drawn through. The knife *D* is bolted firmly to the bed by the screws *i i i i*. The leather is placed upon the cylinder *C*, and drawn through against the knife *D* by the aid of the crank at the end of the machine.

A modification of this machine is shown in Fig. 122, and is used largely for splitting and skinning heads, etc., in the manufacture of sole leather, and upper leather, and for welt leather, and stiffenings for boots and shoes.

Fig. 122.



The machines shown in Figs. 120 to 122 operate by means of rollers, which force the leather against the edge of the knife.

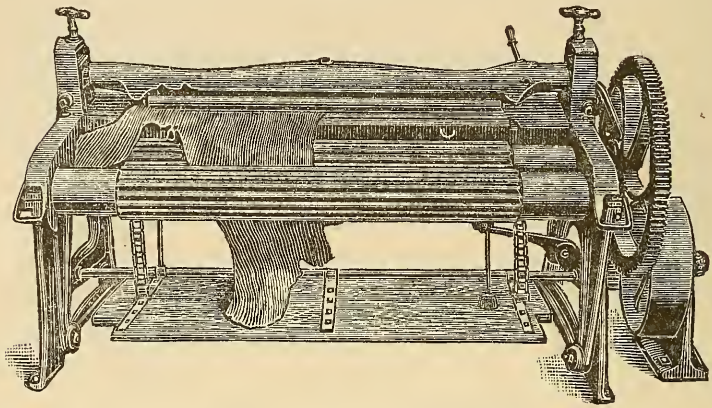
A is the gauge-roller, which is regulated by screws according to the thickness it is desired to split the skin. *B* is the lower roller, which forces the leather, or hide, against the knife, and the two are put in motion by the crank or pulley as the case may be at the end.

Fig. 123 shows a perspective view of an attachment patented in 1883 by John A. Enos, to prevent injury to the arms of those who operate the ordinary splitting machines of the character which have been described above.

As generally practised in the factories of New England, where leather-splitting is carried on largely, the leather is held

pressed against and wrapped around the drawing-roller by the hands of the operator, who is in great danger of being caught and having his arms broken, such accidents being of very frequent occurrence.

Fig. 123.



Machines have also been made in which the leather has been drawn or fed against the edge of the knife or cutter by a pair of cylindrical rolls which act upon the opposite surfaces of the leather, pinching it between them; but when a stationary knife or cutter is employed, it is claimed that it has been found impracticable to use such a pair of feeding-rollers, as their holding power is not sufficient to draw the leather uniformly against the edge of the cutter. Enos discovered that by fluting or corrugating the surfaces of the drawing or feeding rollers, and preferably also gearing them together, so that the projections or convex portions of one roller will fall within the recesses or concave portions of the other roller, it is possible to obtain sufficient holding power upon the leather to draw it properly against the edge of the knife and split the leather.

Enos's invention is shown in detail in Figs. 124 to 126, and consists, essentially, in the combination, with the usual splitting knife and parts co-operating therewith to present the leather properly to its edge, of a fluted or corrugated drawing roller and a corrugated or fluted auxiliary or gripping roller, and mechan-

ism by which the operator can force the rollers against the leather between them.

In the present embodiment of this invention the gripping roller is mounted in bearings upon pivoted arms which are acted upon by an actuating-treadle to draw the gripping roller

Fig. 124.

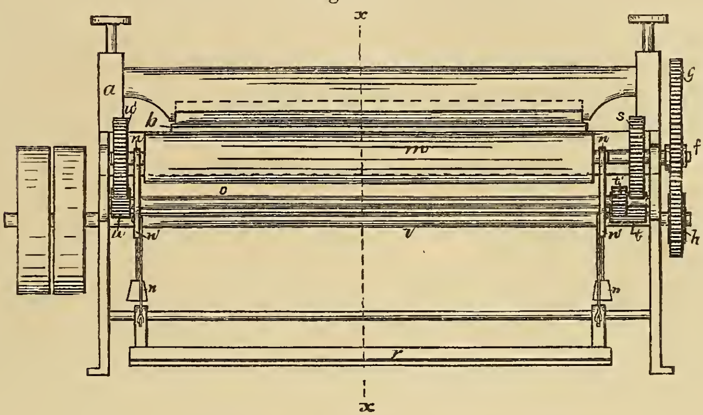


Fig. 125.

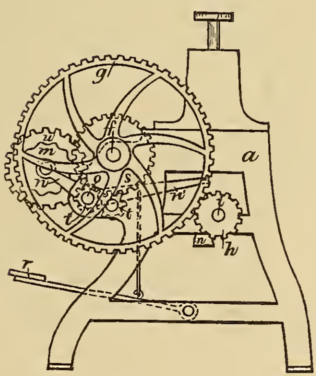
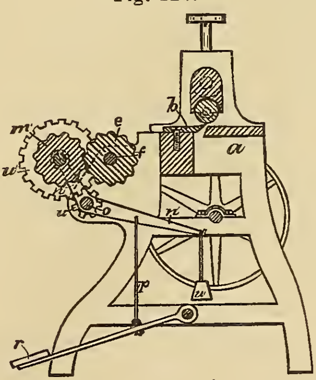


Fig. 126.



toward the drawing-roller, and the gripping roller is drawn back or retracted by its own weight or other suitable retractor, so that the operator by merely raising his foot can at once relieve the pressure on the leather, which will then cease to be drawn.

Fig. 124 is a front elevation of a leather-splitting machine embodying Enos's invention; Fig. 125 an end elevation thereof; and Fig. 126 a vertical section on line x x, Fig. 124.

The framework a, knife b, and mechanism for presenting the leather to be split to the knife-edge may all be of any usual construction, these parts not constituting the present invention. The leather presented to the knife at a short distance from the end of the piece or side has its end carried over the corrugated or fluted drawing-roller e, mounted on a shaft f, shown as actuated by a gear, g, meshing with a pinion, h, on a shaft, i, having the usual fast and loose pulleys for the driving-belt. Thus by wrapping the leather around the roller e, or pressing it against the surface thereof, the leather will be drawn against the edge of the knife and split by the power by which the roller is rotated, although it is necessary, in addition to the power, to provide means for holding the leather upon the surface of the drawing-roller. This is accomplished in accordance with the present invention by the auxiliary or gripping roller m, having its bearings in carrying-arms n, pivoted on the shaft o, so that the roller can be swung or oscillated upon the arms toward and from the roller e. The arms n have extensions n', forming therewith a bent actuating-lever for moving the roller m toward the roller e, the extensions or arms n' being provided with counterbalance-weights, w, for partly balancing the weight of the roller m. The arms n' are connected by links or rods p with the actuating-treadle r, so that the operator, by depressing the treadle, forces the roller m toward the roller e to grip the leather between them. The roller m is corrugated or fluted to correspond with the roller e, as shown in Fig. 126, and the roller e is provided at one end with a gear, s, meshing with an intermediate, t, that meshes with a pinion, t', fixed upon the shaft o, which has at its other end a pinion, u, meshing with a gear u', connected with the roller m. The gears s and u' are of the same size, and the pinions t t'' u are of uniform size, so that the rollers m and e rotate in unison in opposite directions and the projections of the one roller fall into the recesses of the other. The two rollers thus co-operate to grip and draw the leather, which passes down between the rollers instead of being

wrapped around one roller, as in the machines heretofore employed. By the employment, in connection with a fluted drawing-roller actuated by power in the usual manner, of a corresponding fluted auxiliary roller—or, in other words, a co-operating pair of fluting, gripping, and drawing rollers—the danger to the operator, it is claimed, is removed, and the operation and capacity of the machine for splitting the leather are improved and increased.

In the old machines employing but a single roller, the leather, when wrapped around it, frequently forms bunches, causing inequality in the tension of the leather, and consequent inequality in the thickness of the split material.

McDonald and Beggs' Leather Splitting Machine.

The leather-splitting machine shown in Figs. 127 to 131 is the invention of John D. McDonald and William Beggs, of Woburn, Mass., and the invention relates to a leather-splitting machine of that class in which the leather to be split is drawn by a suitable drawing-roller against the edge of a stationary knife, the thickness of the split being regulated by a pressing or gaging roller, the periphery of which is just above the edge of the knife, against which it holds the leather being drawn, so that the thickness of one portion of the leather is equal to the distance between the edge of the knife and the periphery of the roller.

In leather-splitting machines as heretofore constructed the gaging-roller has usually been mounted to turn loosely upon its arbor or bearings, so as not to resist the movement of the leather beneath it.

The present invention consists in the combination, with the pressing or gaging roller, of means to rotate it positively for assisting in feeding the leather against the edge of the knife, and thereby reducing the work of the usual drawing roller. The gaging-roller is mounted in the usual beam, which is pivoted to enable the roller to be lifted up away from the knife to facilitate the introduction of the piece of leather to be split, and in this embodiment of the invention the roller is provided with a pinion meshing with a pinion upon a shaft coincident with the axis

Fig. 127.

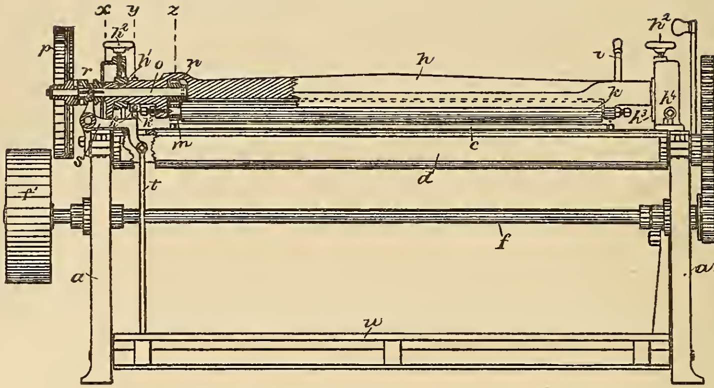


Fig. 128.

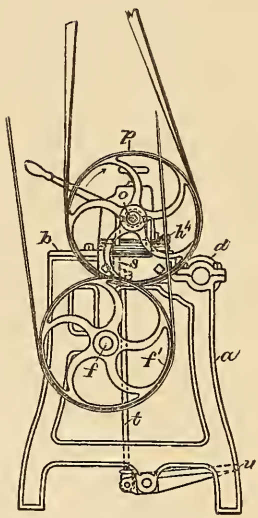


Fig. 129.

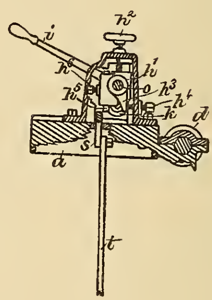


Fig. 130.

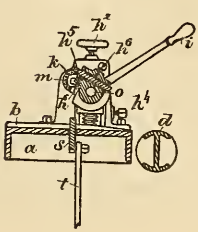
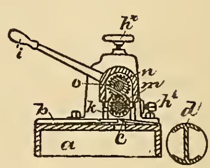


Fig. 131.



of rotation of the beam, and provided with a pulley and clutching device whereby the movement of the gaging and feeding roller may be controlled as desired. A locking device for the beams prevents it from being turned on its pivots by the reaction of the roller in feeding the leather.

Figure 127 is a front elevation of a leather-splitting machine embodying this invention; Fig. 128, an end elevation thereof; and Figs. 129, 130, and 131, sectional details on lines *x*, *y*, and *z*, Fig. 127, the beam being shown in Fig. 130 as turned to the position to raise the gaging-roller for the introduction of the leather.

The frame-work *a*, leather-supporting bed or table *b*, knife *c*, drawing-roller *d*, and its actuating-gears *e* e', the latter mounted on the main actuating shaft *f*, provided with a pulley f', are all of usual construction. The machine is also provided with the usual beam, *h*, pivoted to turn on bearings at h', it being operated by a handle, *i*, and carrying the gaging-roller *k*, by which the leather is held against the edge of the knife *c* and the thickness of the split regulated, the bearings of the beam *h* being adjustable by screws h^2 to determine the thickness. When the beam is turned down to bring the roller *k* into operative position, its movement is limited by the toe h^3, engaging the adjustable stop h^4. (See Fig. 129.)

In order to cause the roller *k* to operate also as a feeding-roller to assist in forcing the leather against the edge of the knife in accordance with this invention, the roller is provided near one end with a pinion, *m*, meshing with a pinion, *n*, upon the roller-actuating shaft *o*, concentric with the bearing of the beam *h*, so that the rotation of the latter to raise and lower the roller *k*, as shown in Figs. 130 and 131, does not disengage the pinions. The shaft *o* has loose upon it a pulley, *p*, actuated by a suitable belt, and having its hub made as one portion of a clutch, the co-operating portion *r* of which is splined upon the shaft, and is moved longitudinally there on to engage and disengage the clutch by a shipping-lever, *s*, connected by a link, *t*, with a treadle, *u*, at the front of the machine. Thus when the treadle is depressed the clutch is engaged and the pulley *p* made to connect with the shaft to rotate it, and, through the pinions

m n, to rotate the roller k in the direction to force the leather against the edge of the knife. By positively rotating the roller k so as to feed the leather, the roller is itself forced backward, tending to turn the beam h from the position shown in Fig. 129 toward that shown in Fig. 130, and such movement is prevented by a locking device, shown as a pin, h^5 (see Figs. 127 and 129), made laterally adjustable by set-screws h^6, and adapted to be engaged by the end of the shipper-lever s when moved to throw the clutch into engagement, and thus apply the power to the roller. If desired, such a locking device may be applied at the other end of the beam h.

The Belt-Knife Splitting-Machine.

Fig. 132 represents a perspective view of the belt-knife splitting-machine, which has already been mentioned, and the one shown is the common size employed for splitting sides of leather, the knife presenting a cutting edge of fifty-seven inches. The manufacturers make another size, the knife of which presents a cutting edge of seventy-two inches for splitting whole hides, as for the manufacture of enamelled leather.

These machines are successfully employed on all varieties of leather.

If proper attention is given to the knives of these machines there is not much liability of annoyance from the other parts, and it is necessary to see that the operatives use proper care in the adjustment of the knife on the machine, and that they especially avoid pinching it too tightly within the jaws. It should also be observed that the knife wheels are kept true, and that they are about $\frac{1}{20}$ of an inch larger in diameter near the flange than they are at the opposite edge. The wheels, when new, are in this form, but, after a time they get worn and require to be newly turned. It is also extremely important that the axle of each wheel presents the same angle to the knife, so that two lines drawn across the edges of the wheels will meet in the centre between the wheels. By observing these directions there will be but little occasion for mending knives. We here take the opportunity to say that a broken knife less than

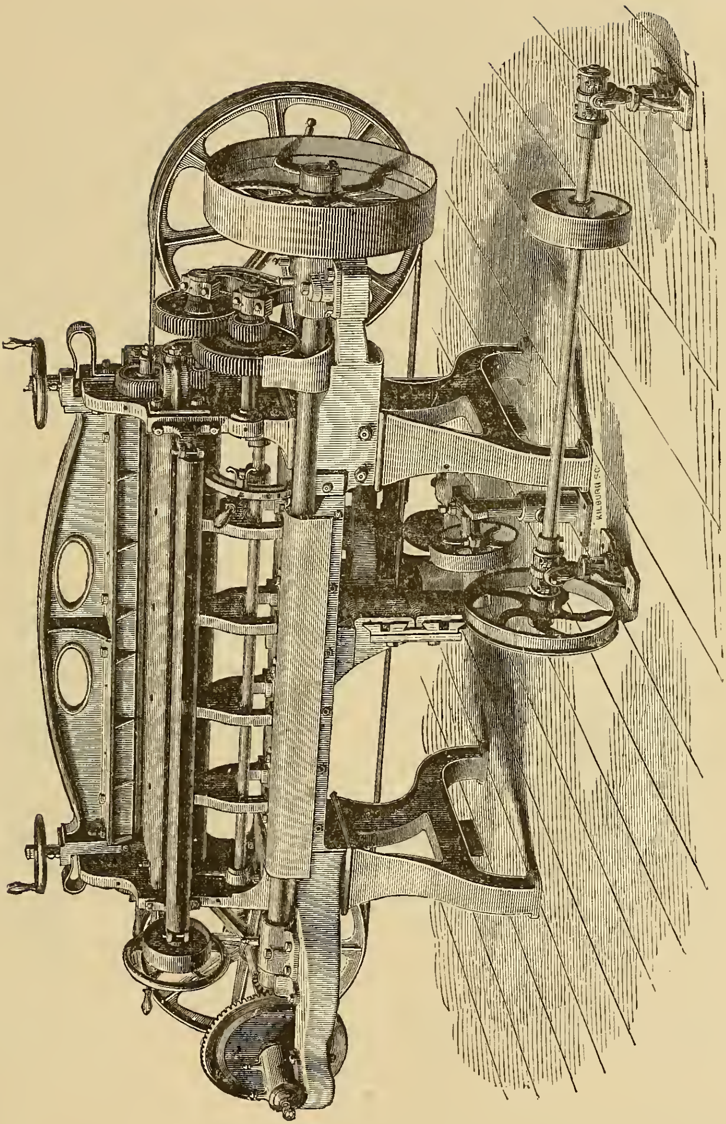


Fig. 132.

two inches in width, is not worth mending, as a knife that is broken at one place, is frequently at the point of breaking in many places.

Eustace Cummings's Improvement in Belt-Knife Splitting-Machines.

Heretofore in leather-splitting machinery having a belt-knife the sides of leather have been fed to the knife by means of the feed and gage rolls arranged in front of the cutting-edge of the knife, and the operator simply guides the same as it leaves the knife and examines it from time to time to see that it is being split to the proper thickness. Cummings claims to have discovered that by the addition of drawing mechanism placed upon the opposite side of the belt-knife from the feed-rolls, which shall produce a constant and uniform tension upon the leather as it is being drawn from the knife, that it can be much more uniformly split than would otherwise be the case. In fact the inventor strongly claims that a substantially perfect result is reached in that the leather is split uniformly or of the same thickness throughout, this result being obtained because it is drawn and held firmly to the gage-roll.

Figure 133 is a back or rear elevation of a belt-knife machine such as made by Barton & Co., of Boston, Mass., containing Cummings's invention. Fig. 134 is a side elevation, and Fig. 135 is a vertical cross-section.

A represents the belt-knife. It is revolved by means of driving wheels or pulleys in the ordinary way.

b b' b^2 represent the ordinary feed-rolls of the Barton machine. The roll b is a rubber-covered roll, which revolves the smaller sectional roll b', and the leather is fed between this smaller sectional roll and the gage-roll b^2 to the knife. It is of course apparent that there is a space between the cutting edge of the knife and the portions of the rolls which almost impinge, and which is sufficient to cause the leather to be pressed from a straight path and down from the gage-roller as it is being fed to the belt-knife, and it is this movement from a straight line that causes the leather to be split unevenly. It is equally apparent that if the leather be drawn taut upon the knife this fulness between the cutting-edge and the feed and gage-rolls is prevented. This is claimed to be accomplished in the present invention by means of the drawing mechanism, consisting, pre-

Fig. 133.

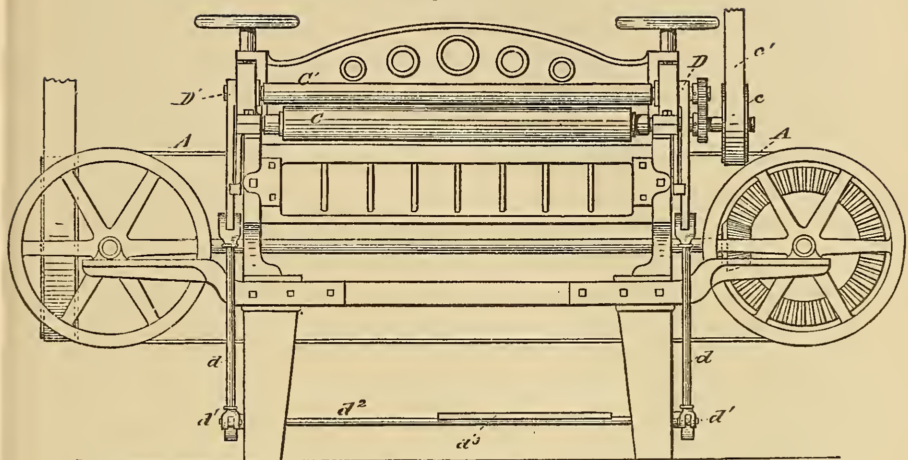


Fig. 134.

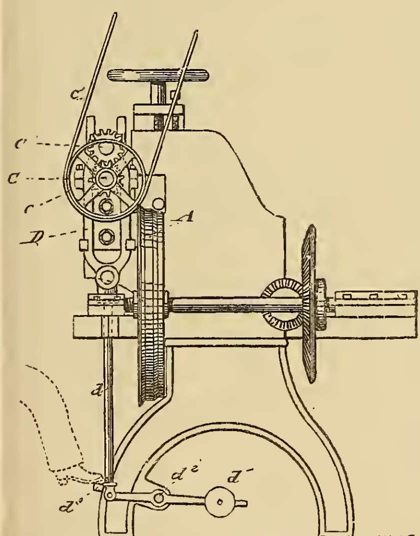
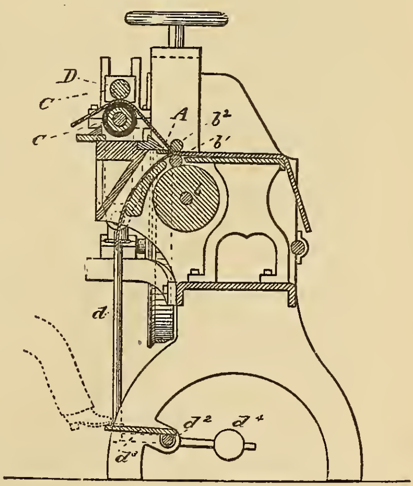


Fig. 135.



ferably, of two rollers C C', positively driven from any suitable shaft by means of a belt, c, and pulley c', or in any other desirable way. These rollers are run at a speed greater than the speed of the feed and gage-rollers. The lower of the two rollers

preferably is covered with rubber, felt, or other like material; but while this is an improvement upon a metal-surfaced roller yet the inventor does not wish to be understood as limiting himself thereto. The rollers are arranged above the plane of the knife, so that the split portion of the leather takes a diagonal course upward thereto after leaving the knife. The upper roller is provided with a vertical movement in relation to the lower roller so that it may be moved to receive the forward end of the leather as it passes the knife, and also to permit of the adjustment of the leather while it is being split, or, on account of its shape (when a side), it does not feed uniformly in a straight line. This is accomplished by means of the sliding boxes D D', the rods d, the lever d', connecting-bar d^2, and the treadle d^3, and it is preferable that the construction be such that the upper roller shall automatically lift from the lower roller, and this may be accomplished either by counterbalancing weights d^4, attached to the bar d^2, or by means of springs adapted to lift the treadle and the upper roller. In this case the front portion of the side of leather passes the knife, enters between the two rollers, and the operator then with his foot presses the upper roller down upon the leather and lower roller sufficiently to give as much tension or friction thereon as may be desired, and as the rollers revolve faster than the feed-rollers the leather is drawn taut between the feed and drawing rollers and upon a straight line parallel with the rollers, but somewhat inclined between the drawing-rollers and the feed-roller. The teeth of the gear-wheels upon these rollers are made long, so that a separation of the rollers can take place without interfering with the positive rotation of either roller, so that when the upper roller is brought down upon the sides it will be rotating at the same speed as the lower-roller.

By this device Cummings claims to be enabled to split the leather to a uniform degree of thickness, and thereby dispense with the subsequent shaving now necessary, and consequently save the cost of much labor, as well as prevent the waste of the stock; that which before made shavings forming a portion of the split leather, and of course making it stronger, heavier, and of better quality.

It is not necessary in all kinds of work to use both drawing-rollers, as the lower one, especially when covered with a frictional material, like rubber, will answer to draw the hide, especially when held down thereon by hand.

List of all Patents for Leather Splitting Machines, issed by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*[1]

No.	Date.	Inventor.	Residence.
	July 9, 1808.	S. Parker,	
	Jan. 7, 1809.	S. Boyden,	Newark, N. J.
	April 26, 1809.	S. Parker,	
	July 12, 1810.	P. Dow,	Boston, Mass.
	April 5, 1813.	S. Parker,	
	May 3, 1820.	E. Howard, and J. Butters,	Boston, Mass.
	May 31, 1822.	J. Butters,	New York, N. Y.
	April 23, 1831.	A. Richardson,	Boston, Mass.
	Dec. 31, 1833.	J. P. Shaw and J. C. Briggs,	Boston, Mass.
1,010	Nov. 20, 1838.	E. Putnam,	Danvers, Mass.
1,272	Aug. 2, 1839.	H. White,	Binghamton, N. Y.
1,967	Feb. 9, 1841.	A. Richardson,	Boston, Mass.
3,541	April 17, 1844.	A. Richardson,	Boston, Mass.
5,456	Feb. 22, 1848.	J. P. Fairlamb,	Wilmington, Del.
8,227	July 15, 1851.	W. Panton,	Milton, Mass.
8,369	Sept. 16, 1851.	A. Richardson,	North Enfield, N. H.
9,980	Aug. 30, 1853.	C. Weston,	Salem, Mass.
11,604	Aug. 29, 1854.	J. F. Flanders and J. A. Marden,	Newburyport, Mass.
12,114	Dec. 9, 1854.	E. Pratt,	Salem, Mass.
12,392	Feb. 13, 1855.	M. H. Merriam and J. B. Crosby,	Chelsea, Mass. Stoneham, Mass.
13,407	Aug. 7, 1855.	J. B. Tay,	North Woburn, Mass.
13,756	Nov. 6, 1855.	J. A. Marden and H. A. Butters,	Newburyport, Mass. Haverhill, Mass.
14,430	Mar. 11, 1856.	E. Pratt,	Salem, Mass.
22,108	Nov. 23, 1858.	H. E. Chapman,	Albany, N. Y.
23,900	May 10, 1859.	D. H. Chamberlain,	West Roxbury, Mass.
28,559	June 5, 1860.	D. H. Chamberlain,	West Roxbury, Mass.
29,649	Aug. 14, 1860.	J. F. Flanders,	Boston, Mass.
30,553	Oct. 30, 1860.	S. S. Turner,	Westborough, Mass.

[1] This list does not include skinning and leather splitting machines used in the manufacture of boots and shoes, only those used in tanneries and currying shops.

No.	Date.	Inventor.	Residence.
31.746	Mar. 19, 1861.	J. A. Safford,	Boston, Mass.
35,850	July 8, 1862.	A. H. Van Gieson,	Newark, N. J.
38,763	June 2, 1863.	B. Rowe,	Albany, N. Y.
39,695	Aug. 25, 1863.	H. Wing,	Buffalo, N. Y.
41,448	Feb. 2, 1864.	J. A. Safford,	Boston, Mass.
43,159	June 14, 1864.	C. S. Stearns,	Marlborough, Mass.
53,741	April 3, 1866.	J. A. Marden,	Newburyport, Mass.
53,771	April 10, 1866.	C. W. Baldwin and L. D. Hawkins,	Charlestown, Mass. Stoneham, Mass.
54,043	April 17, 1866.	A. H. Van Gieson,	Newark, N. J.
54,571	May 8, 1866.	J. A. Marden,	Newburyport, Mass.
70,175	Oct. 29, 1867.	A. Dawes,	Hudson, Mass.
74,734	Feb. 18, 1868.	F. J. Vittum,	Newburyport, Mass.
75,823	Mar. 24, 1868.	J. H. Abbott and J. A. Marden,	Malden, Mass. Boston, Mass.
78,697	June 9, 1868.	C. S. Stearns,	Marlborough, Mass.
83,888	Nov. 10, 1868.	J. Taggart,	Boston, Mass.
95,780	Oct. 12, 1879.	H. Cunningham,	Albany, N. Y.
98,068	Dec. 21, 1869.	C. Keniston,	Somerville, Mass.
98,888	Jan. 18, 1870.	J. A. Safford,	Winchester, Mass.
100,082	Feb. 22, 1870.	C. S. Stearns,	Marlborough, Mass.
123,589	Feb. 13, 1872.	C. S. Stearns,	Marlborough, Mass.
139,744	June 10, 1873.	A. F. Stowe,	Worcester, Mass.
144,899	Nov. 25, 1873.	J. Goebel and J. Preis,	Caledonia, Wis.
147,172	Feb. 3, 1874.	G. Reynolds,	Woburn, Mass.
149,542	April 7, 1874.	C. S. Stearns,	Marlborough, Mass.
156,652	Nov. 10, 1874.	J. A. Safford,	Winchester, Mass.
179,948	July 18, 1876.	H. F. Osborn,	Newark, N. J.
191,855	June 12, 1877.	J. Hodskinson,	Salem, Mass.
209,001	Oct. 15, 1878.	A. E. Whitney,	Winchester, Mass.
211,187	Jan. 7, 1879.	J. A. Safford,	Boston, Mass.
230,895	Aug. 10, 1880.	J. A. Safford,	Boston, Mass.
244,196	July —, 1881.	C. Daneel,	New York, N. Y.
278,562	May 8, 1883.	J. E. Enos,	Peabody, Mass.
279,659	June 19, 1883.	J. D. McDonald and W. Beggs,	Woburn, Mass.
288,551	Nov. 13, 1883.	E. Cummings,	Woburn, Mass.

PART VI.

CHAPTER XXI.

SCOURING.

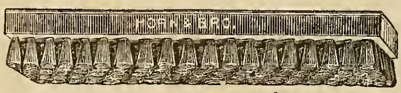
After the leather has been split it is commonly handled in liquor for about two weeks, which completes the tanning process, and the next operations to which it is to be subjected are the drying and finishing for market.

Of course different varieties of leather pass through different modes of treatment, and while there is but little to be done in the finishing of sole leather, except the drying and rolling, there is much to be done in finishing upper leathers, Morocco leathers, etc.

We shall therefore devote one chapter to each of the subjects of scouring, stuffing, blackening, and polishing leather, and then for other details of special branches of manufacture and for coloring and dyeing leather, refer the reader to the various chapters treating of those subjects.

The tools used in the hand method of scouring leather are the brush, stone, and slicker; the brush is shown in Fig. 136,

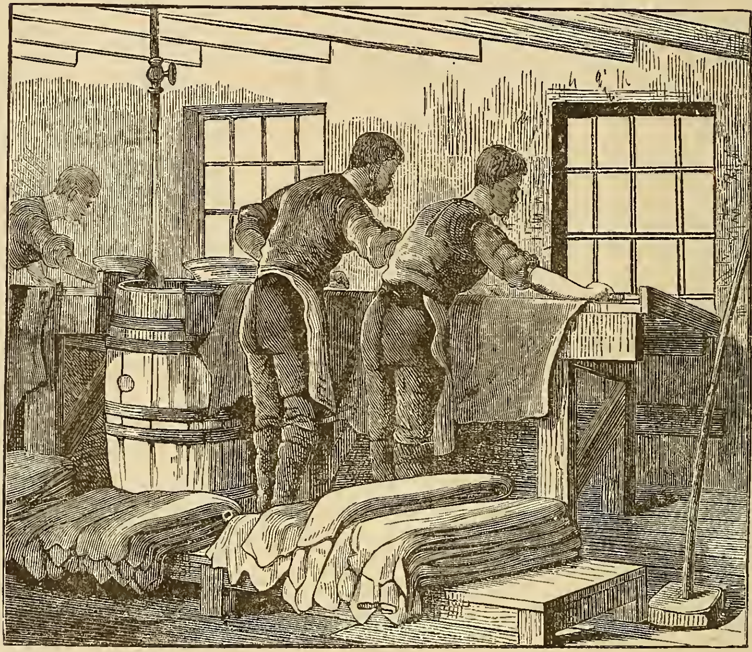
Fig. 136.



and the perspective view, Fig. 137, shows the form of tables and other mechanical details connected with the hand method of scouring leather.

This manner is laborious and expensive, which has caused it to be superseded almost entirely by machinery.

Fig. 137.



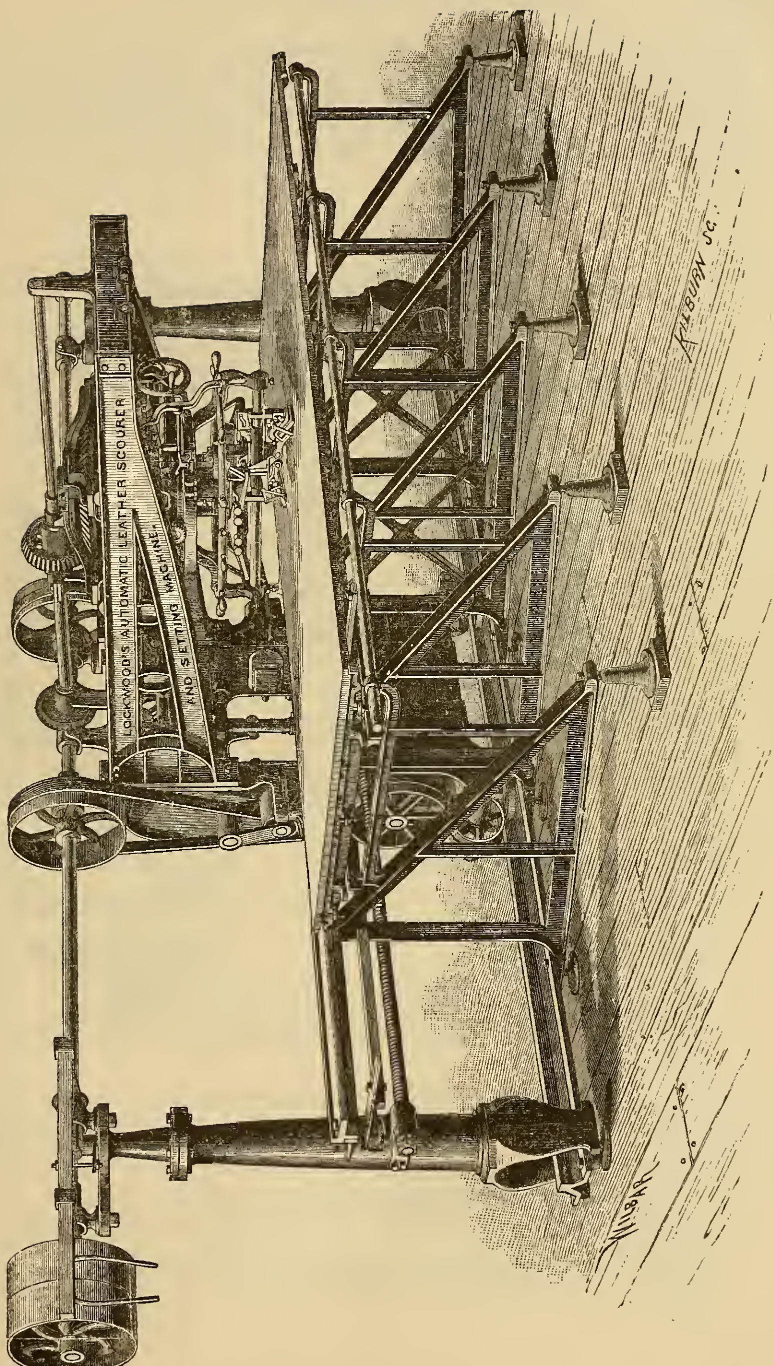
A review of all the leather-finishing machines that have been perfected since 1867 will, I think, show none of so much importance to the tanner and currier as the leather scouring and setting machines which have, during that time, become so common in our tanneries and currying shops.

Some of these machines are so arranged as to do simply the scouring, while others will perform either the scouring or setting.

Lockwood's Machine.

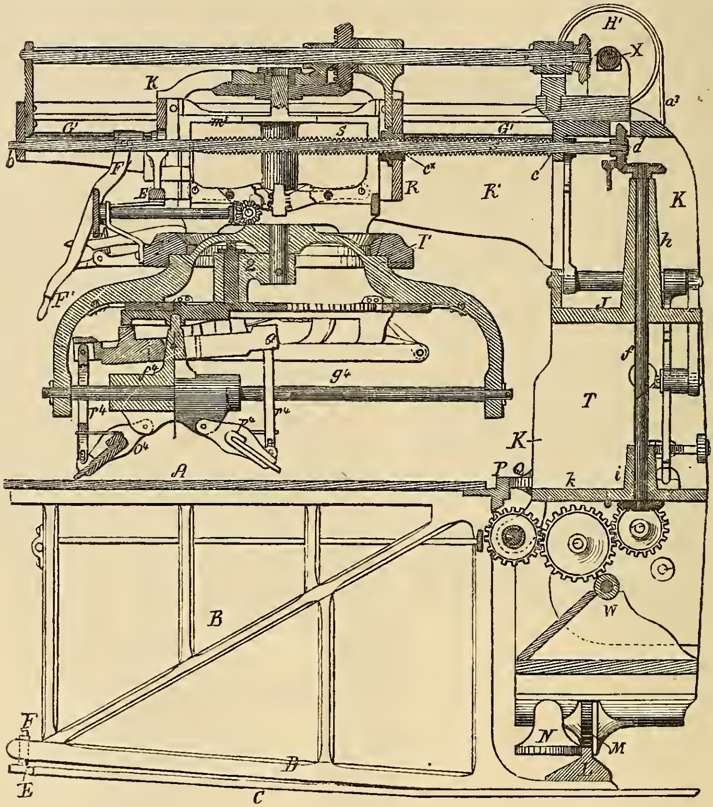
The Lockwood Automatic Leather Scourer and Setting Machine. shown in Figs. 138 to 140, is valuable for performing the work of scouring all kinds of leather that are thus treated, or for setting calf-skins, kip, buff, and wax.

Fig. 138.


LOCKWOOD'S AUTOMATIC LEATHER SCOURER
AND SETTING MACHINE.
KILBURN SC.

It is a costly machine, but its work is so satisfactory that I have not heard a complaint against it in the various large tanneries and currying shops, where I have seen it in operation, in the neighborhood of Woburn, Salem, Peabody, and other points in Massachusetts.

Fig. 139.



In one tannery, that of Messrs. Bryant & King, located near Woburn, Mass., the author saw seven of these machines setting calf-skins, and was much surprised at the ease with which they were operated and the excellence of the finished work.

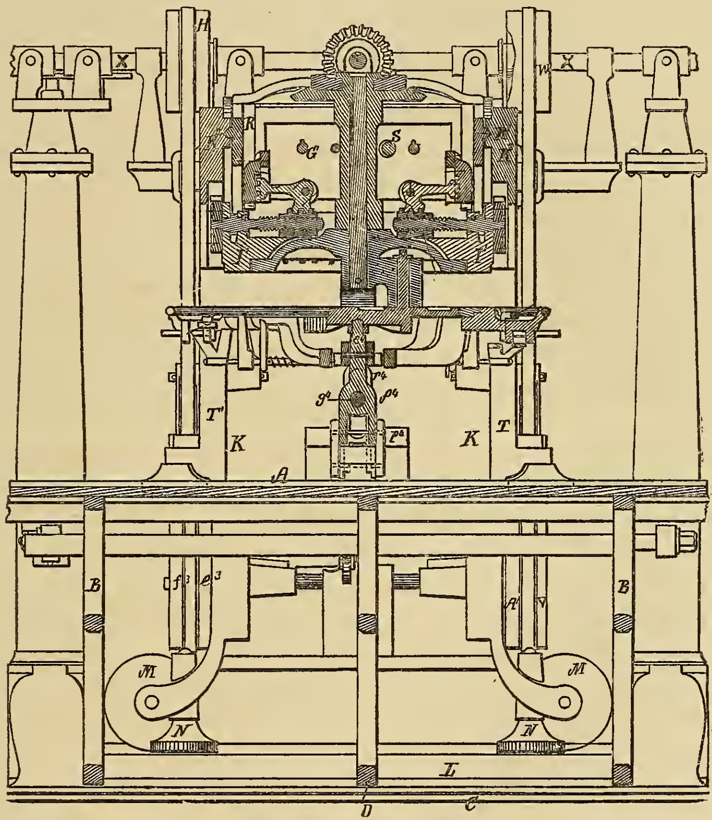
Fig. 138 shows a perspective view of the Lockwood machine.

Fig. 139 is a vertical and longitudinal section of the same.

Fig. 140 is a vertical transverse section of the same.

The table A is supported upon a stage, B, which is erected upon the floor C of the apartment or the foundation of the machine, whatever the latter may be; and the inventor has made provision for levelling the table A, or adjusting it to slop-

Fig. 140.



ing or irregular floors or foundations. In the drawings, the floor is represented as sloping and depressed at the rear, which is desirable in order that refuse water and liquids may pass off.

To compensate for the inclination or irregularities of the floor C, the inventor prefers to dispose the front ends of the lower beams, D, of the stage B, upon metallic blocks, and screw through

the ends of the beam screws to bear upon the blocks, by which means the irregularities or inclination of the floor are overcome.

In the rear of the table A is disposed an upright truck, K, the movements of which are guided by a horizontal rail, L, secured to the rear ends of the beams D and parallel to the edge of the table. Wheels M are interposed between the truck K and rail L to reduce friction, while a second series of rollers, N, are pivoted to the feet of the truck and roll upon or against the front edge of the rail, and serve as rolling bearings to retain the wheels M in place upon the rail L and overcome the great friction incident to leverage of the truck over the upper rail, P (see Fig. 140), as a fulcrum. The inventor pivots to the adjacent parts of truck antifriction rollers Q, which travel against the rear edge of the ledge or upper rail, P.

The trundle-frame R of the carriage m (shown in Figs. 139 and 140) is placed between the side pieces, R^2 R^3, of the horizontal beam R' of the truck, and has V-shaped bearings to fit correspondingly-shaped grooves a in these side pieces. The carriage, composed of the trundle-frame R and vertically-adjustable head m^5, is moved longitudinally with relation to the beam R' and transversely of the table by means of a screw-threaded shaft, S (see Fig. 140), held in suitable bearing, b c, the screw fitting a threaded nut, c^x, fixed to the rear part of the trundle-frame of the carriage. The screw-shaft S is rotated by a bevelled gear, d, fixed to its rear end, which bevelled gear is engaged and driven by a second bevelled gear, e, secured to the upper end of a vertical shaft, f, which is supported in bearings h i, erected on bars j k, which unite the side plates or housing, T T', of the truck K.

When the strokes of the tools are to be repeated several times in the same direction the handle of the catch is raised and that of the latch elevated by the spring 2, interposed between the two, the nose of the latch being thereby forced into one of the notches j^4, and the yoke, with the hand-wheel, is thus locked to the annular plate I' of the head of the carriage. Mr. Lockwood's object in thus locking the yoke and hand-wheel is to relieve the attendant from the manual labor of holding the guide-

bar g^4 in a fixed position, which is essential to impart rectilinear motion to the tools.

The tool-holders o^4 p^4, pivoted to the tool-carrier f^4, will be lifted from the skin during their backward stroke.

When it is desired that the tool-carrier, with the dressing-tools, be moved diagonally across the table, it is necessary to simultaneously move both the carriage on the beam R' and the truck K on its rails. This is accomplished by moving the handle of the guide-lever F' in the direction it is desired the tool-carrier to take, the movement of the guide-lever simultaneously turning the rock-shafts G' W', causing the bands to rotate two of the pulleys A', e^3, V, or f^3, which is necessary in order to insure the proper direction of the movement of the parts. This hand-operated guide-lever F', the position of which determines the direction of movement of the tool-carrier and tools, and the position of the dressing-tools with relation to the skin, greatly simplifies the labor of the attendant, places the machine more perfectly under his control, and consequently enables more and better work to be done.

The present invention is an improvement on the machine which was patented by the same inventor in 1876.

In devising this later machine, Lockwood had in view, first, to drive the operative parts of the machine by direct positive mechanical devices in lieu of a belt, thereby insuring uniform and certain actions of the various agencies and reducing the power required to run the machine; and, second, to relieve the attendant to a great extent of the constant care and watchfulness heretofore devolving upon him, and enable the main functions of the machine to be controlled by a single hand or guide-lever.

In order to obviate the lifting of the beam when the dressing-tools are lifted, and to give increased rigidity at the junction of the beam-arms and truck, Lockwood has made the beam-arms as a fixed part of the truck, and divided the so-called "cross-head" or carriage into two parts, one of which we will denominate as the "trundle-frame" and the other as the "head." This head is made vertically adjustable with relation to the horizontally-movable trundle-frame, and there is mounted in this head the axially-movable yoke having upon it the guide-rod which

receives the reciprocating tool-carrier. The head in the present invention is made vertically adjustable by means of a hand-operated shaft located at the front of the machine, and such adjustment may be made during the operation of the machine. The truck is made movable longitudinally with relation to the skin-supporting table by means of a rotating nut placed on a screw-threaded rod held in a fixed part of the frame-work of the machine. This nut may be rotated in one or the other direction on the rod, the ends of the nut acting against the truck to move the same longitudinally. This nut and screw enable the truck to move positively in both directions and hold the truck firmly in place, thus dispensing with pawls and their actuating mechanism.

There are also other improvements in this machine over the one patented by the same inventor in 1876, such as driving the operating parts of the machine, positively by means of shafting and gearing instead of belting, and also in substituting a single lever in lieu of the double-hand levers for controlling the truck on the ways and the so-called "cross-head" and carriage.

The new Lockwood machine, as will be seen by Fig. 138, has a large table on which to place the stock, so that one workman can be preparing a side at one end while the other will be directing the machine in the automatic setting out of a side previously arranged on the other end. The working thus keeps two men constantly busy, but the physical labor required is light, for the machine takes all this. The strokes made are either strong or light, as desired, being directly under the control of the operator, who, with his hand on the wheel, guides and almost, as it were, feels them. So, in going over the bellies and flanks, working out folds and thoroughly setting out thick portions of a side, the work is not only done quickly and well, but the leather is made to measure enough more, on all stock sold by the foot, to quickly pay for the machine in the gain thus made.

Holmes's Machine.

The Holmes Scouring, Setting, and Hide-Working Machine is shown in Figs. 141 to 145, and is an improved form of the old Fitzhenry and Ball, and Pray and Fitzhenry machines.

Fig. 141.

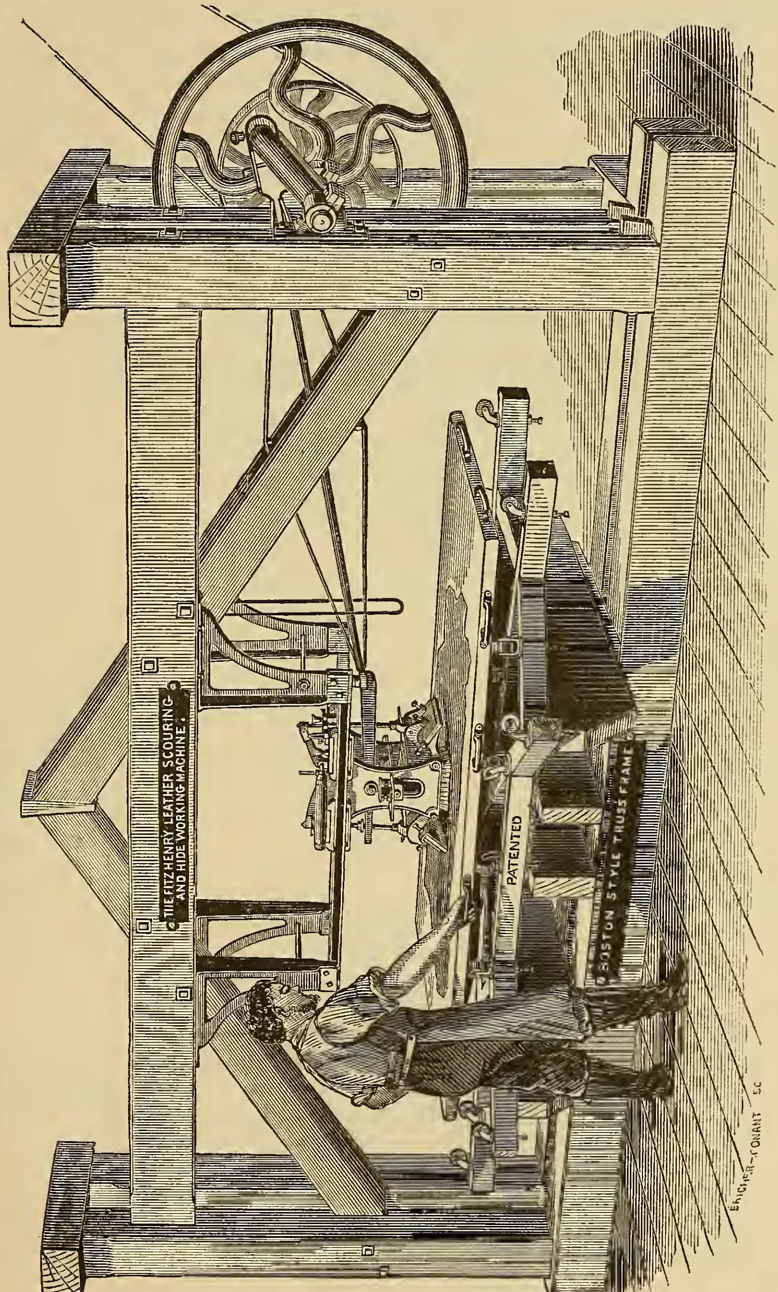
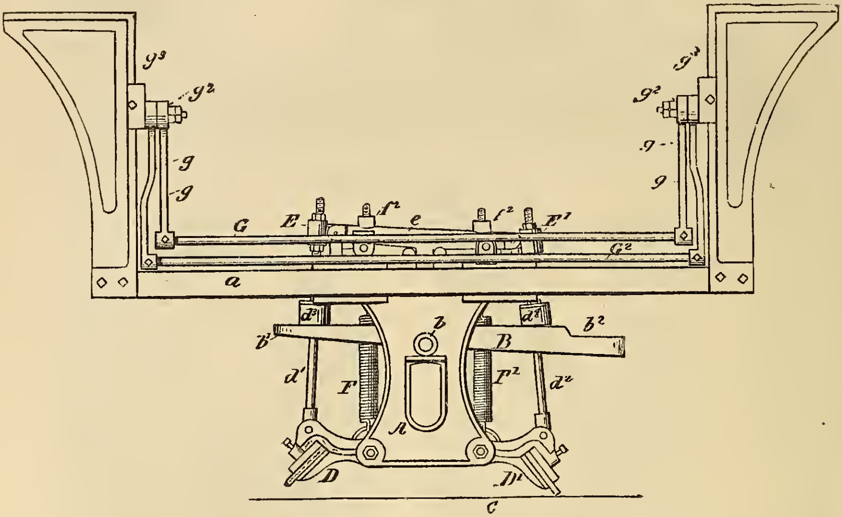

THE FITZHENRY LEATHER SCOURING
AND HIDE WORKING MACHINE.
PATENTED
BOSTON STYLE TRUSS FRAME

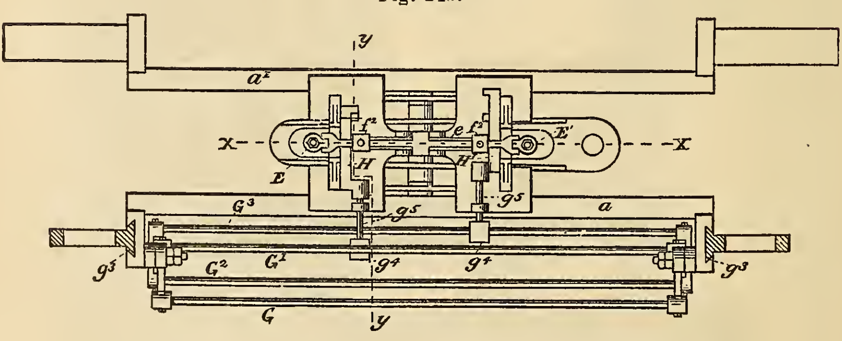
Fig. 141 shows a perspective view of the machine in operation; Fig. 142 is a front elevation of the portion of the machine

Fig. 142.



embodying Holmes's improvement of March 8, 1881; Fig. 143 is a plan thereof; Fig. 144 is a vertical section on the line $x\ x$ of Fig. 143; Fig. 145 is a vertical section, to which reference will be made hereafter.

Fig. 143.



In operating this machine the hide is laid upon the table, which is mounted upon rollers, and provided with universal

movement on a horizontal plane beneath the head A, and the cranks set in motion. This causes the tools to be applied alternately, according to the direction of movement of the tool head, to the skin or leather with a slicking motion.

Fig. 144.

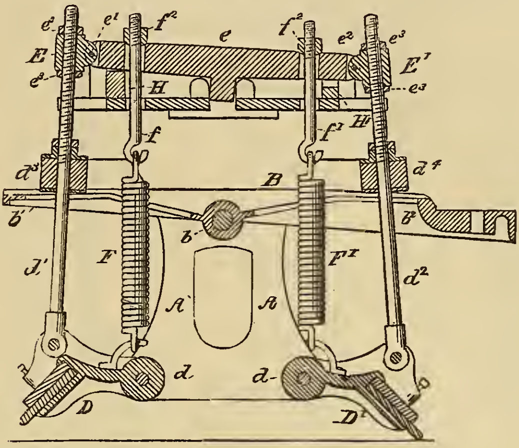
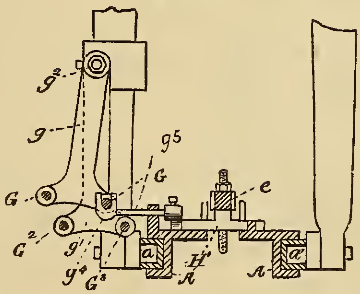
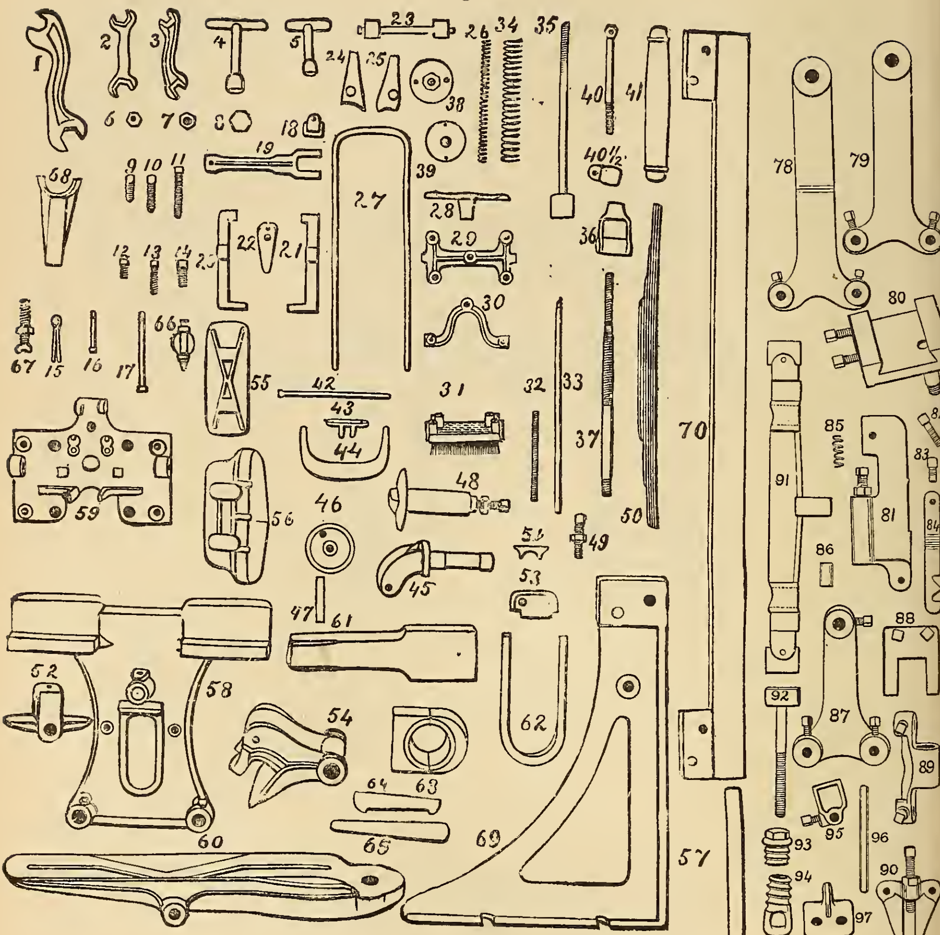


Fig. 145.



The head or framework A is arranged to be reciprocated upon the horizontal and parallel ways a a' by a crank and connecting-rod or pitman, B. This connecting-rod or pitman, or an extension thereof, is pivoted at b to the head A, and a portion extends beyond the pivot, and consequently as the head is reciprocated, the end b' and the point b^2 are alternately lifted and lowered in relation to the line C of the table upon which the hide is scoured, finished, or otherwise treated, and this oscillating

Fig. 146.



Holmes's Improved Scouring Machine Parts.

1. S. Wrench, $\frac{7}{8}$ in. and $1\frac{1}{8}$ in. Hexagon.
2. S. " $\frac{5}{8}$ " $\frac{3}{4}$ in. "
3. S. " $\frac{3}{8}$ " $\frac{1}{2}$ in. Square.
4. T. " $\frac{1}{2}$ in.
5. T. " 5–16 in.
6. $\frac{3}{8}$ in. Hexagon Nut.
7. 7–16 in. " "
8. $\frac{5}{8}$ in " "
9. 7–16 in. x 1 in hardened Set Screw.
10. 7–16 in. x $1\frac{1}{2}$ in. " "
11. 7–16 in. x $2\frac{1}{2}$ in. " "
12. $\frac{3}{8}$ in. Tap Bolt for Brake Springs.
13. $\frac{1}{2}$ in. x $1\frac{1}{2}$ in. hardened Set Screw.
14. $\frac{1}{2}$ x 1 in.
15. Spring Pins.
16. 5–16 in. x 2 in. Steel Pins.
17. $\frac{3}{8}$ in. x 4 in.
18. Brass Lever Nuts.
19. ———Levers.
20. L. H. Slide Brake.
21. R. H. " "
22. Brake Spring.
23. 5–16 Brush Pin and Tools.
24. R. H. Brush Cam.
25. L. H. " "
26. Brush Spiral Spring.
27. Brush Handle.
28. Brush Top Bar.
29. Brush Pressure Bar.
30. Brush Roll Holder.
31. Brass Back Brush.
32 Brush Top Screw.
33. Brush Rod $\frac{3}{8}$ in.
34. Spiral Tool Spring.

movement of this portion of the connecting-rod or pitman in relation to the centre b is utilized for the purpose of alternately lifting the tools from the work and allowing them to bear upon the work.

The tool-carriers D D' are pivoted or hinged at the points d to the head A, and the tool-carrier lifting-rods d' d^2 lay hold of the tool-carriers and are provided with buffers d^3 d^4. The inventor connects the nuts or blocks E E' by the long arm or lever e, which is pivoted at e' e^2 to the blocks. He prefers that the lifting-rods d' d^2 be provided with a screw-thread, and that their position in relation to the blocks E E' be adjusted by the nuts e^3.

The tools are held down to their work by means of the contractile power of the coiled springs F F', which, at their lower ends, are connected with the tool-carriers, as represented, and at their upper ends hook upon the rods f f', which are adjustably secured to the arm or lever e by the nuts f^2.

This construction and combination of springs, tool-carriers, lifting-rods, oscillating lifting rod or plate, and connecting lever

---

35. Spiral Spring Tool Rod.
36. Stirrup.
37. Tool Rod $\frac{5}{8}$ in.
38. Flanged Nut
39. Rubber Cushion.
40. Handle Rod.
40½. Handle End.
41. Wood Handle.
42. Table Handle Pin.
43. Table Handle Ear.
44. Table Handle.
45. Caster Holder.
46. Caster Roll.
47. Caster Pin. } Caster Complete.
48. Caster Shell.
49. Caster Screw Nut.
50. Elliptic Spring.
51. Stirrup Guard.
52. Spring Holder.
53. Pressure Box.
54. Tool Holder.
55. Stone Guard.
56. Water Guard.
57 $\frac{5}{8}$ in. Tool and Oscillator Pin.
58 Side of Carriage.
59. ½ Top of Carriage.
60. Oscillator.
61. Connecting Rod End.
62. " " Strap.
63. " " Box.
64. " " Gib.
65. " " Key.
66. " " Oiler.
67. " " Truss Screw.
68. " " Truss Post.
69. Brackett.
70. Slide.

Stationary Stone Handle:

78. Long Right Hand.
    Long Left Hand for Latch Screw.
79. Short Right Hand Arm.
    Short Left Hand for Latch Screw.
80. Bracket Clamp, Left Hand with Stud.
    Bracket Clamp, Right Haud with Stud.
81. Latch Spring Holder.
82. Tap Bolt for 81.
83. Latch Catch Screw.
84. Latch Right Hand.
    " Left Hand.
85. Latch Spring.
86 Latch Press Pin.

Stationary Brush Handle:

87. Brush Haudle Arm.
88. " " Clamp, Right Hand.
    Brush Handle Clamp, Left Hand.
89. Brush Handle Slide.
90. Pressure Screw Ear and Screws.

91. Spiral Spring Top Lever.
92. Pressure Screw.
93. Spiral Spring Nut End.
94. " " Loop End.
95. Slide Brake, U. Slide.
96. " " Connecting Rod.
97. Spiral Spring Hook.

Parts not Illustrated.

71. Wood or Brass Gibs $\frac{5}{8}$ thick.
72. Walpole Machine Stones.
73. Brass or Steel Slickers.
74. Crank Shaft.
75. Pulleys.
76. Balance Wheel.
77. Post Boxes.

or arm, give and permit a uniform and equable pressure upon the tool-carriers, and consequently upon the tools, at all points of their reciprocation or stroke, and this was not the case with the mechanism of the old form of these machines.

For lifting one or both tool-carriers during the reciprocation of the head from their work Holmes employs the two pairs of rods, G G' and G^2 G^3, arranged so that each pair is supported at both ends by independent swinging arms g g', which are pivoted at g^2 to any suitable stationary portion of the device for holding the frame a'. One of the two pairs of arms g g' is longer than the other pair, in order that each pair of rods may be on a different level. Upon each of the inner rods, G' G^2, there is arranged a slide, g^4, and one of these slides, by means of a connecting-rod, g^5, connects with the latch or slide-bar H, and the other slide, g^4, by means of a like connecting-rod, g^5, connects with the latch or slide-bar H'. Both these slide-bars are adapted to be pushed under the lever e, for the purpose of holding the tool-carrier from the work when desired.

Mr. Charles Holmes died shortly after improving this machine; but since the fall of 1883 his estate has continued the manufacture of these machines at the old stand in Boston, Mass.

For the convenience of those owning and operating these machines who may desire to order duplicate parts, we show them in Fig. 146.

Fitzhenry's Machine.

Figs. 147 to 151 show the latest improvement on the Fitzhenry Leather-Dressing Machine, and it consists in the construction and arrangement of the devices for raising and lowering the tools, and for starting and stopping the same to and from the work.

Fig. 147 is a perspective view. Fig. 148 is a side elevation of the steam cylinder and carriage embodying Fitzhenry's invention. Fig. 149 is a partial longitudinal section of the same. Fig. 150 is a transverse vertical section thereof; and Fig. 151 is a view of detached parts of the machine.

A represents the steam-cylinder provided on its sides with the grooved ways a, in which the frame or carriage B is moved

Fig. 147.

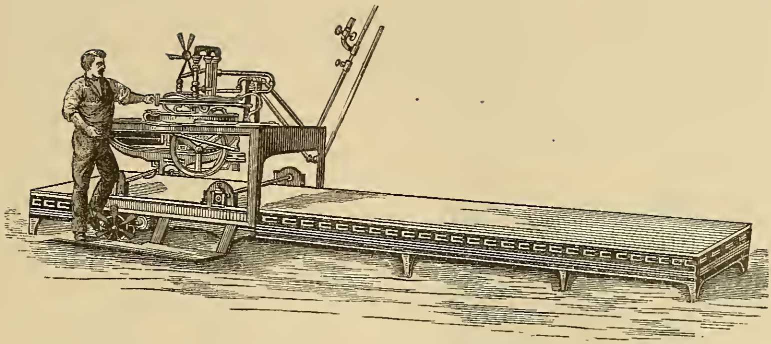


Fig. 148.

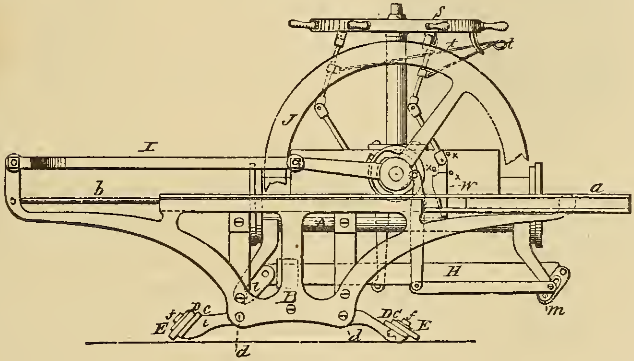
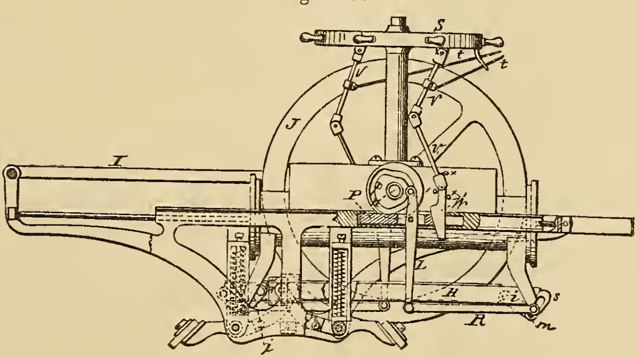


Fig. 149.



back and forth by the piston-rod *b* passing through both ends of the cylinder. In the lower portion of the frame or carriage *B* at each end is a rocking shaft, *d*, with arms *e e* projecting outward therefrom, and to the outer ends of these arms the tool-

Fig. 150.

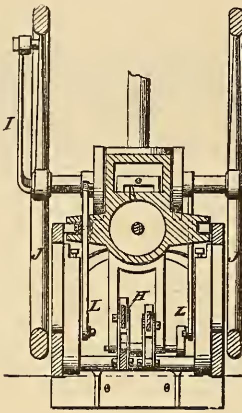
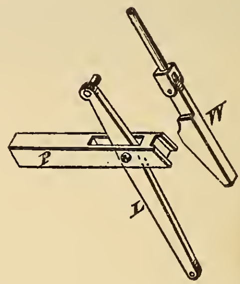


Fig. 151.



holder *C* is secured. *D* is the tool, and *E* the covering-plate, which are fastened to the tool-holder by screws *f f* passing through them. From the back of each rocking shaft *d* extends an arm, *h*, which is curved upward, as shown, and the upper portion slotted or forked and pivoted to a slide, *G*. This slide or sleeve is placed loosely on a bar, *H*, to each end of which are pivoted two links, *i i*. The links at one end of the bar *H* are placed loosely on a shaft, *m*, while the links at the other end are secured to a similar shaft *m*. The two bars *H H* with their links are so arranged that each shaft *m* has two links fast thereon and two loose links.

At one end of the frame or carriage *B* are pivoted two pitmen, *I I*, which connect with and operate two fly wheels, *J J*, placed on the ends of a shaft, *n*, above the cylinder *A* in the centre. On this shaft are secured two cams, *p p*, each of which operates a lever, *L*, pivoted in a slotted bar, *P*, placed in the framework connected to the cylinder. The lower ends of the levers *L L* are, by bars or rods *R R*, connected with cranks *s s*

on the shafts m m—that is, one lever connects with one shaft, and the other lever with the other shaft.

When the machine is in operation the shafts m m are rocked by means of the cams p, levers L, connecting-bars R, and cranks s, whereby the bars H are moved lengthwise, and alternately raised and lowered, thereby alternately raising and lowering the tools.

S is the hand-wheel for swinging the entire mechanism in any direction. On the under side of this wheel are two rods, t t, each of which connects with hinged levers V V carrying a wedge, W. These wedges are pushed down in grooves at the ends of the fulcrum-bars P P to hold them stationary while the machine is in operation. To stop the tools it is only necessary to push the rods t inward, when the wedges will be drawn and the bars or boxes P become movable, thereby removing the fulcrums of the levers L so that they will not operate. The wedges W are guided in their up and down movement by means of pins x x.

Burdon's Machine.

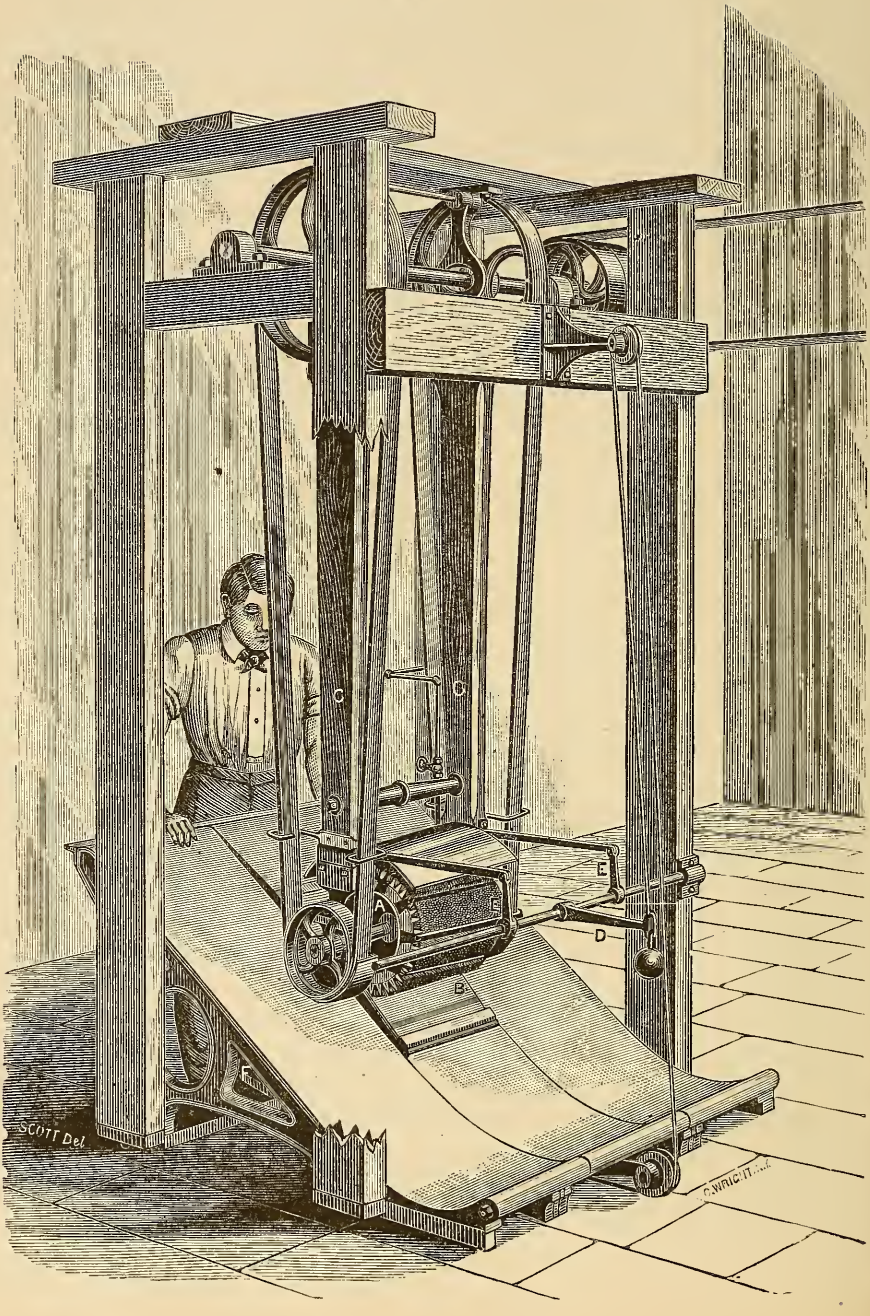
The Burdon Machine is shown in Figs. 152 to 154, and it is for dressing, setting out and scouring hides, skins, and leathers; and has for its object to facilitate the operation by providing for a perfect adjustment of all parts to hides varying in thickness and quality.

The invention consists, chiefly, in the use of a rotating, scouring, and rubbing cylinder, which is hung in a pendulum-frame, so that it can be swung any suitable distance from the bed that supports the hide to be dressed.

Fig. 152 shows a perspective view of the machine, and Fig. 153 shows a side view, partly in section, of the cylinder and elastic bed.

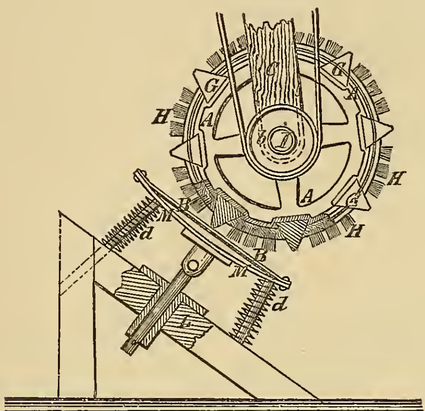
The scouring cylinder A revolves upon an adjustable and elastic bed B, as shown in Figs. 152 and 153. The scouring surface of the cylinder consists of a succession of stones and brushes, arranged in alternate rows, and secured to its surface. The pressure of the cylinder upon its work is regulated by moving the pendulum frame C, in which the scouring cylinder

Fig. 152.



revolves towards and from the bed. This is done by means of the arms *D* and *E*, which being connected with the treadle *F*, are at the control of the operator. This latter feature of the machine renders it equally applicable to the heaviest sole and belt leather, and to the thinnest splits and calf-skins.

Fig. 153.



The pendulum frame *C* is suspended from the upper driving-shaft, and carries at its lower end a horizontal shaft. A belt connects the pulleys for the purpose of transmitting motion to the shaft *I*.

Upon the shaft *I* is mounted the scouring cylinder or disk *A*, which carries the rubbing or scouring implements, in the form of stones *G* and brushes *H*.

Each stone is made of triangular or other suitable form, and is dovetailed into a dovetail groove of the cylinder *A*, being locked therein by a wedge or key, *c*.

The bed *B* is arranged above a fixed table *L*, and is by springs *d d* underneath, held against and in contact with the scouring cylinder.

The under portion *M* of the bed *B* is concave, and over it is stretched, by being fastened to the ends, a sheet of rubber, leather, or other flexible or semi-elastic material. This sheet constitutes an elastic cushion for the material to be treated.

This is a valuable labor-saving machine; it removes the bloom

and softens the grain in a thoroughly satisfactory manner, is economical in space, requiring only about 6x6 feet square and 9 feet height. It scours flanks and shanks with as much facility as the body of the side, and it does its work equally well on all grades and qualities of leather, from the heaviest band or harness leather to the finest and lightest calf or goat-skins. It is well adapted for the tanyard, cleansing the hide effectually from lime and from the bate, and preparing it for the handlers. It is also well adapted for removing bloom from sole leather after it is tanned, and preparing it for the roller.

Fig. 154 is a side elevation of the Burdon scouring machine, and shows the arrangement and another manner of hinging the

Fig. 154.

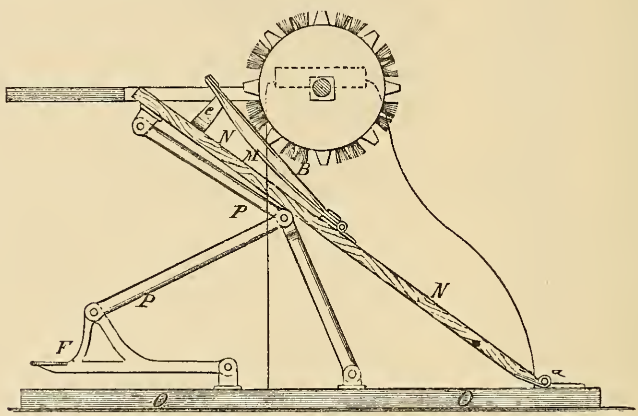


table differing from that shown in Fig. 153. In Fig. 154 the table is made adjustable by means of levers, and Fig. 154 also shows a manner of hinging the spring-bed and combining it with the table.

The scouring-bed *M* is at one end hinged to a table, *N*, which is by a hinge, *a*, secured to a fixed platform or floor, *O*.

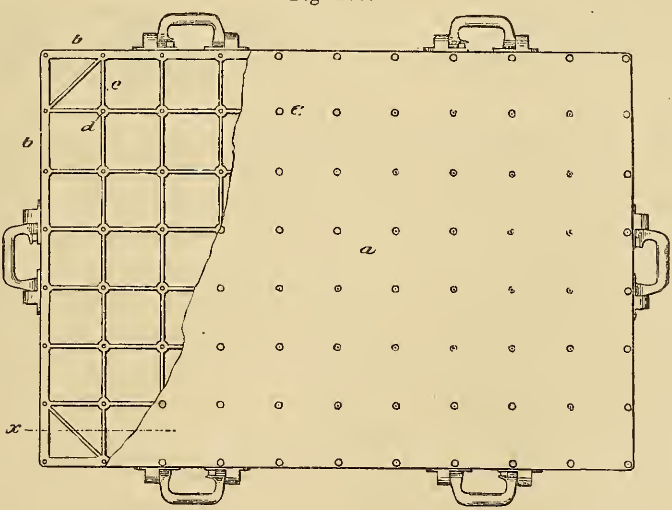
A set of toggle levers, *P*, or other suitable mechanism, applied against the under side of the table, and connected with a treadle or handle, *F*, can be used to force the table and bed with suitable power against the cylinder.

A spring or springs, e, interposed between the free end of the bed M and the table, serves to hold the bed against the cylinder. The upper or contact face of the bed may be made slightly concave, as shown, to receive a sheet, B, of leather, rubber, or other material, which is stretched over its ends to constitute a cushion surface, upon which the leather to be treated is placed.

Daheney's Table for Leather-Scouring Machines.

Daheney's table for leather-scouring machines is shown in Figs. 155 to 159, and the invention has for its object to produce a more durable and convenient table than those heretofore used for this purpose. The tables usually employed at the present time are either of wood or of slate, both of which materials are expensive and are rapidly worn out, the table thus having to be renewed frequently.

Fig. 155.



This table is composed of two metal plates and an intermediate strengthening framework connected with the said plates, to support them at various points between their surfaces, substantially as described.

Fig. 155 is a plan view of a table embodying this invention, a portion of the surface-plate being removed to show the sup-

porting framework; Fig. 156, a side elevation thereof, showing the table mounted on rollers or casters in the usual manner; Fig. 157, a partial plan view of a modified form; and Figs. 158 and 159, sectional details on lines *x* and *y* of Figs. 155 and 157, respectively, on a larger scale.

Fig. 156.

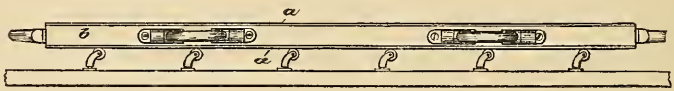


Fig. 157.

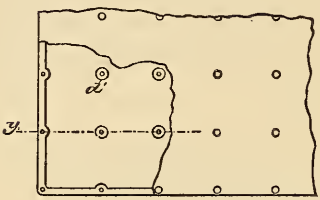


Fig. 158.

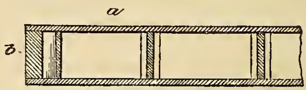
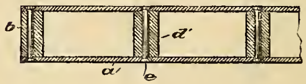


Fig. 159.



The table consists, mainly, of a surface plate, of thin metal, preferably of sheet-steel, and a strong rectangular frame, *b*, passing wholly around the table and connected with the edges of the surface-plate *a*. As shown in Figs. 155 and 158, the frame *b* has connected with it a series of thin webs or ribs, *c*, the points of intersection of which are enlarged to afford sockets *d* for rivets *e*, or other fastenings, by which the surface-plate *a* is connected with the framework, the webs with their intersecting points forming rests to support the thin surface-plate at intermediate points or between its edges.

When the table is intended to be movable upon rollers, as shown in Fig. 156, there will be similar surface-plates *a* at both sides of the framework *b c d*, the plates being preferably united by rivets passing wholly through the table, and being finished even with the surface.

In some cases it will be sufficient if the webs are omitted and tubular posts *d′* used at suitable intervals, as shown in Figs. 157 and 159, they forming the rests to support the surface-plates *a*,

and keep them parallel with one another, the posts having passages for the shanks of the rivets *e*, as shown.

In some instances one surface-plate *a* only might be used, and the plate, together with the strengthening ribs or framework, might be made from a single piece of metal, although it is usually preferable to make the surface-plates independently and fasten them upon the stiffening framework.

List of all Patents for Scouring[1] *and Setting Machines, issued by the Government of the United States of America, from* 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	Nov. 21, 1831.	R. Emes,	Boston, Mass.
17,576	June 16, 1857.	P. E. Hummel,	Pulaski, N. Y.
49,606	Aug. 29, 1865.	W. M. Clarke,	Butternuts, N. Y.
60,149	Dec. 4, 1866.	F. Davis,	Lawrence, Kan.
61,182	Jan. 15, 1867.	E. Fitzhenry and I. Ball,	Portland, Oregon.
61,250	Jan. 15, 1867.	J. A. Pray and E. Fitzhenry,	Portland, Oregon.
63,307	Mar. 26, 1867.	A. W. Roberts,	Hartford, Conn.
65,224	May 28, 1867.	A. Howard and G. F. Howard,	Wellsville, Md. Chicago, Ill.
76,619	April 11, 1868.	E. Fitzhenry,	Boston, Mass.
79,832	July 14, 1868.	A. Howard, and G. F. Howard,	Wellsville, Md. Chicago, Ill.
84,001	Nov. 10, 1868.	F. W. Rust,	Umatilla, Oregon.
90,664	June 11, 1869.	C. Holmes,	Boston, Mass.
98,121	Dec. 21, 1869.	J. T. Melrose,	Boston, Mass.
100,387	Mar. 1, 1870.	E. Fitzhenry,	Boston, Mass.
101,508	April 5, 1870.	A. W. Reed,	Schenectady, N. Y.
102,270	April 26, 1870.	S. Hutchinson,	
105,419	July 19, 1870.	D. P. Burdon,	New York, N. Y.
106,439	Aug. 16, 1870.	J. R. Williams,	Salem, Mass.
108,782 108,783	Nov. 1, 1870.	H. C. Havemeyer and D. P. Burdon,	New York, N. Y.
114,809	May 16, 1871.	D. Harrington,	Boston, Mass.
117,921	Aug. 8, 1871.	J. C. Parmerlee,	Bean Blossom, Ind.
118,002	Aug. 15, 1871.	E. Fitzhenry,	Boston, Mass.
118,003	Aug. 15, 1871.	E. Fitzhenry,	Boston, Mass.
119,513	Oct. 3, 1871.	E. Fitzhenry,	Boston, Mass.

[1] For other forms of scouring machines, see those combined with unhairing machines in list on page 333.

No.	Date.	Inventor.	Residence.
125,276	April 2, 1872.	E. Fitzhenry,	Somerville, Mass.
129,251	July 16, 1872.	A. W. Reid,	Schenectady, N. Y.
131,831	Oct. 1, 1872.	N. F. Snow,	Salem, Mass.
143,829	Oct. 21, 1873.	F. A. Lockwood,	Boston, Mass.
151,144	May 19, 1874.	J. Maxwell,	Woburn, Mass.
154,249	Aug. 18, 1874.	J. Head,	Andover, N. Y.
156,991	Nov. 17, 1874.	E. Fitzhenry,	Somerville, Mass.
157,691	Dec. 15, 1874.	F. A. Lockwood,	Boston, Mass.
173,627	Feb. 15, 1876.	J. Head,	Andover, N. Y.
176,216	April 18, 1876.	H. D. Chemberlin and J. P. Luther,	Berlin, Wis.
179,928	July 19, 1876.	F. A. Lockwood,	Boston, Mass.
180,018	July 18, 1876.	E. Fitzhenry,	Somerville, Mass.
193,615	July 31, 1877.	W. Panton.	Quincy, Ill.
194,806	Sept. 4, 1877.	T. L. Daheney,	Stoneham, Mass.
196,793	Nov. 6, 1877.	C. T. Ford, and S. A. Ford,	Salem, Mass.
235,131 Reissue 9,824	Dec. 20, 1880. Aug. 2, 1881.	J. W. Cubbage,	Gallipolis, O.
238,589	Mar. 8, 1881.	C. Holmes,	Boston, Mass.
240,997	May 3, 1881.	W. Goodman,	Boston, Mass.
252,369	Jan. 17, 1882.	W. Goodman,	Boston, Mass.
258,659	May 30, 1882.	F. A. Lockwood,	Boston, Mass.
260,492	July 4, 1882.	J. C. Mayer,	Somerville, Mass.

CHAPTER XXII.

STUFFING LEATHER—HAND STUFFING AND STUFFING WHEELS—STUFFING AND CURRYING COMPOUNDS—MACHINE FOR REMOVING GREASE FROM LEATHER—LIST OF AMERICAN PATENTS FOR STUFFING APPARATUSES AND FOR STUFFING AND CURRYING COMPOUNDS.

Section I. Hand Stuffing and Stuffing Wheels.

In the manufacture of upper leather, after the sides have been scoured as described in the preceding chapter, they are exposed to the air to harden and are next carried to the cellar of the shop to be dampened and tempered, so as to facilitate the absorp-

tion of the grease; the tempering process generally extending through two days.

The period of tempering depends upon whether the leather is to be stuffed by hand or machinery. When stuffed by hand the leather requires to be damper than when stuffed by means of the wheel.

Ordinarily the hand process of stuffing leather is accomplished after rolling the sides into bundles with the grain side in and softening them by treating or beating, and then applying to the flesh side by means of a brush, a mixture of oil and tallow in a heated state. In addition to the trouble and expense of the hand method of stuffing another objection arises from the fact that the leather has to be dampened to such an extent that it necessitates a long period for drying, and then again, after the partial absorption of the oleaginous and fatty materials the surface of the leather has to be separately cleaned of the unabsorbed matter.

Another great objection to the hand method of stuffing leather is that the stuffing materials, unless great care is observed, penetrate only slightly beyond the surface, thereby leaving the leather, as regards the main body, dry and unchanged, and consequently hard. But when the modern stuffing wheel is used for this purpose the leather is usually thoroughly permeated and thereby rendered soft and pliable.

Stuffing Wheels.

The first stuffing wheel patented in this country was invented by L. W. Fiske, of Louisville, Ky., early in 1855, although previous to this time they had been used in France and Germany in the crude form of a revolving hogshead.

But those which are now in use in the United States are of permanent construction, and show the usual evidence of mechanical ingenuity for which American inventors are pre-eminent.

Reed and Winchester's Stuffing Wheel.

The stuffing wheel shown in Figs. 160 and 161 is the invention of Reed and Winchester.

This invention in stuffing leather has for its object a method

whereby the grease may be put into the leather more regularly than heretofore. The leather must be warm, and be kept warm uniformly during the time the grease is being applied to it.

The leather to receive grease or stuffing is usually placed in a rotating drum or wheel previously heated by steam or hot air blown into it while the wheel is empty, for it has been found that steam injected into the drum in the presence of the leather is apt to burn it. A drum heated only before placing the leather in it commences to cool immediately thereafter, and the stuffing or greasing operation is retarded. Another serious objection to the direct introduction of steam into the drum with the leather and grease is that arising from water of condensation, as even a small amount of water added at that time, the leather having been evenly and sufficiently moistened before it was placed in the drum, will be taken up by the leather, thus lessening the amount of grease entering the leather at that spot where the water of condensation in the grease meets the leather, and, further, the heat derived from free steam varies materially, according to the pressure of steam in the boiler. To obviate the objection of free steam the drum has been placed in a second drum heated by steam.

In this invention the interior of the drum and leather therein are kept at the desired temperature by means of heated air forced therein while the drum containing its charge of leather is being rotated. The hot air is supplied to the drum by a blower or pump through pipes, in connection with a receiving-chamber of a suitable heat-generating apparatus.

Figure 160 represents, in vertical section, an apparatus embodying Reed and Winchester's invention, the wall of the heat-generating apparatus being also in section. Fig. 161 is an elevation of the left-hand end of the drum, the latter being partially broken out.

The drum *a*, about seven feet in diameter, has a door, *b*, for the introduction of the leather therein, and a series of pegs, *c*, at suitable intervals apart to lift and tumble the leather as the drum is rotated, all as usual. This drum has at one journal a pipe, *d*, for the introduction at suitable times of hot grease, and at its other journal it has a pipe, *e*, for the continuous admission

of hot air while the drum is being rotated with the leather and grease therein. The pipe *e* is preferably placed, in coil or other form, in the combustion-chamber *f*, heated in any usual way, so that air forced through the pipe by an air-forcing apparatus,

Fig. 160.

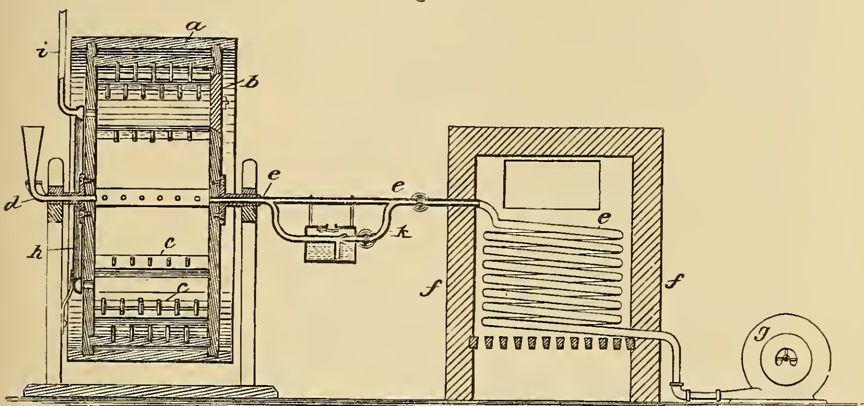
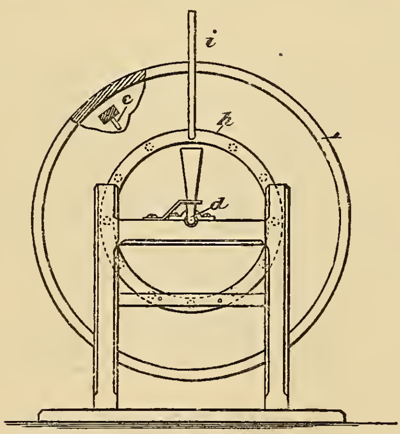


Fig. 161.



g (shown as a blower, but which might be a pump), will be heated before reaching the drum. The side of the drum will be provided with openings of suitable size for the escape of the heated air, so as to maintain proper circulation. The air so escaping might be delivered into an annular chamber, *h*, placed

next to the openings of the wheel (see Fig. 160), having a pipe, *i*, to lead the air out of the building, if desired.

The air-pipe, at a point between the chamber *f* and drum, may have a branch, *k*, by which, if desired, to divert the heated air into a water-box and over a pan of water, to thus add a little moisture to the hot air, if too dry; or we may inject a small amount of steam into the pipe *e* containing the hot air, to slightly moisten it, care being taken to so regulate the steam that no water of condensation is permitted to form or enter the drum.

In this process it is possible to keep the interior of the drum and the leather therein at a uniform temperature, which may be indicated by a thermometer properly connected with the drum which enables the leather to be greased or stuffed uniformly and rapidly, and that without fear of injuring the leather in any way by over-heating, as when steam is depended upon, or by too rapid cooling, as when the drum is heated only before applying the leather. The grease, in proper quantities, can be introduced from time to time, as needed.

This valuable invention appears to have been suggested by that of Dr. Friederich Knapp of Brunswick, Germany, who invented an improvement in tramping-drums in 1878, which possessed the combination of the drum and hollow trunnions and the blower or fan and other arrangements very similar to the stuffing wheel which has just been described; but while our Government granted Knapp a patent for the fan attachment to the stuffing wheel the German Government had previously refused it as not being a new idea.

Frederick Carl's Improved Stuffing Wheel.

The stuffing wheel shown in Figs. 162 and 163 is the invention of Frederick Carl, and is an improvement upon the machine patented by him in 1867.

Figure 162 is an isometrical perspective view, and Fig. 163 a vertical longitudinal section of Carl's improved stuffing wheel.

A represents the body or cylinder of the machine, which is journaled at *B* in the supporting-frame *C*, and provided with an opening, *D*, for inserting the leather. A steam-supply pipe,

E, passes through one of the journals B, with which it revolves, and thence at right angles upwardly along the outer side of one end of the body A, as seen at F, terminating in the branches d d', for conveying steam to the twin or corresponding heater disposed within the cylinder, of which the heater is shown at G in Fig. 163.

Fig. 162.

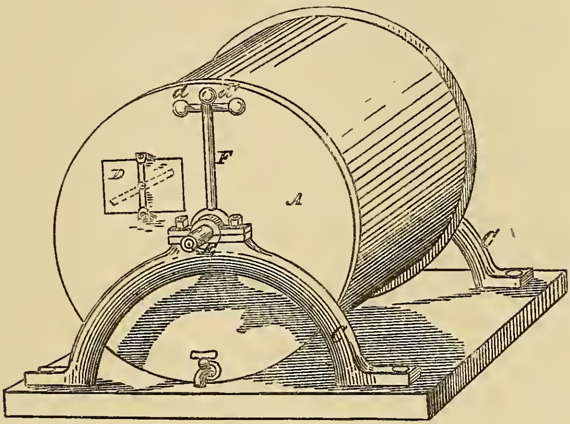
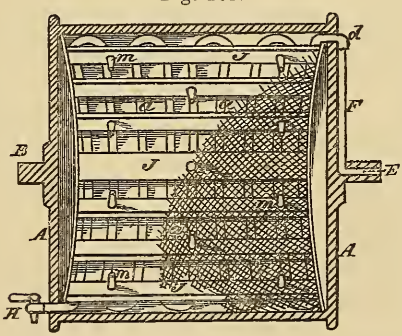


Fig. 163.



The heater consists of a continuous pipe, or pipe without joints, bent to form parallel sections a a, and curved laterally to conform to the interior curvature of the cylinder, a drain-pipe or stopcock, H, being provided to draw off the water of condensation.

A series of slats or bars, J J, provided with pins m m for catching and holding the leather, are secured longitudinally

within the cylinder, the heaters *G* being disposed between said bars and the outer casing of the body *A*. There is also a screen or wire-netting, *K* (shown as partially removed in Fig. 163), attached to the bars *J J*, the pins *m m* projecting inwardly through the netting when the same is in position. The netting forms the interior side walls of the cylinder, its object being to effectually prevent the leather from coming into actual contact with the pipes without preventing the heater from properly acting on the stuffing or leather contained in the cylinder.

In the use of this stuffing wheel, steam having first been let into the apparatus through the pipe *E*, the leather and composition for stuffing the same are inserted in the body *A* through the opening *D*, which is then securely closed, and the cylinder caused to rotate by any suitable means, thus rapidly and effectually performing the operation of stuffing in a manner which will be readily understood by all conversant with such matters without a more explicit description.

The wheel may be made to revolve either by suitable gear-wheels or a belt may be passed from a pulley on a revolving shaft around the cylinder *A*.

List of Patents for all Apparatuses for Stuffing and Greasing Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	1855.	L. W. Fiske,	Louisville, Ky.
40,079	Sept. 22, 1863.	G. Huttelmaier,	Allegheny, Pa.
63,856	April 16, 1867.	F. Carl,	Charlestown, Mass.
78,815	June 9, 1868.	H. Muller,	North Cambridge, Mass.
78,835	June 9, 1868.	J. W. Schayer,	Boston, Mass.
100,939	Mar. 15, 1870.	H. Smith, Jr.,	Milwaukee. Wis.
131,777	Oct. 1, 1872.	W. A. Perkins, and J. A. Enos,	Salem, Mass. Peabody, Mass.
147,379	Feb. 10, 1874.	J. A. Enos,	Peabody, Mass.
153,654	July 28, 1874.	G. H. Williams,	Milwaukee, Wis.
177,576	May 16, 1876.	J. A. J. Shultz,	St. Louis, Mo.
201,526	Mar. 19, 1878.	J. W. Hildreth,	Boston, Mass.
219,233	Sept. 2, 1879.	N. H. Dodge,	Brooklyn, N. Y.
245,321	Aug. 9, 1881.	J. A. J. Shultz,	St. Louis, Mo.
245,975	Aug. 23, 1881.	H. P. Reed, and P. L. Winchester, Jr.	Peabody, Mass.
249,455	Nov. 15, 1881.	F. Carl,	Somerville, Mass.

SECTION II. STUFFING COMPOUNDS.

Andrews's Compound.

In 1869 Robert Andrews improved upon a method patented by him in 1867, for preparing a composition for stuffing leather, and for all purposes in which grease, oils, or tallow are used in manufacturing leather.

This method consists of combining, mixing, and compounding common or crude tar with tallow, beeswax, linseed oil, neat's-foot oil, and the oil of tar, in such proportions, and in such a way and manner as to cause the particles of each to assimilate and form a composition to be used principally in the manufacture of leather, and chiefly for "stuffing."

The method of making this composition embraces simply the process of effecting a combination of the tar, tallow, and oils. Ordinarily, common or crude tar will not unite with tallow and oil.

But Andrews claims to effect this process as follows: Put together into a large caldron or iron vessel a quantity of tallow, oil of tar, beeswax, linseed oil, and neat's-foot oil, in such quantity of each as is proper, chiefly in the following proportions and quantities:

Linseed oil	1 gallon
Neat's-foot oil	1 gallon
Oil of tar	$\frac{1}{4}$ pound
Tallow	10 pounds
Beeswax	1 pound

and heat them over a slow fire until they boil or attain the highest degree of heat without igniting. Then take of this boiling mixture small quantities at a time, in a scoop or dipper, and pour it carefully into the vessel containing the crude or common tar which has been prepared for compounding. While the heated oils are thus being gradually introduced into the tar, cause it to be agitated and moved by stirring it with some instrument. After the tar becomes warmed and softened, quickly and at once pour the whole of the remainder of the boiling oils which has previously been made ready for the purpose, and

mix the entire mass thoroughly until there is a complete mingling of the whole. Before the mixture cools, again put it into an iron caldron and subject it to a slowly increasing heat until it boils, being careful to avoid ignition. Then draw the liquid off into a vessel and let it stand until it becomes cold, when it is ready for use.

Stuffing compounds of this character impart great consistency to fats, and such combinations as that which has just been given insure a good purpose, the only objection being that leathers so treated are liable after a time to become dry and stiff.

Merrill's Compound.

In 1870 Joshua Merrill patented a stuffing compound, composed of solid paraffine mixed with tallow, fish oil, rosin, rosin oil, and tar of commerce, or either of them.

Paraffine, having no tendency to absorb oxygen, acts as an antiseptic, preventing the oxidation of such substances as those above mentioned, and like substances, thereby preventing them from drying or hardening in the pores of the leather.

By "solid paraffine," is meant either the article known in the market as "scale paraffine," or that known as refined paraffine.

A compound composed of thirty-three parts paraffine, thirty-three parts rosin, twenty-four parts rosin oil, and ten parts rendered tallow, makes a stuffing or dressing for leather of great value, finishing goat and sheep-skins it is claimed so that they resemble calf-skins. It renders them soft and pliable, and they finish with a beautiful surface.

This compound, it is also claimed, finishes calf-skins equal to good French calf, and at comparatively small cost, as compared with the high-priced oils usually employed for dressing the kinds of finer leather.

A composition of thirty-three parts paraffine, thirty-three parts rosin, fourteen parts rosin oil, ten parts North Carolina tar or tar of commerce, and ten parts of tallow or fish oil, also makes a good compound for stuffing leather.

In manufacturing this paraffine stuffing compound, use a kettle heated by fire directly applied, or by steam heat (by means of a double-walled kettle), such as usually employed in melting

glue, into which first put the paraffine, then the rosin oil and tallow or fish oil, with the tar, when used, and heat them until thoroughly melted and heated to about 220° F. Then allow it to rest until it is clear and bright, when it is ready for use, if the operation has been properly conducted.

The paraffine stuffing compound thus made will be clear and bright, and when rubbed between the fingers will be soft and unctuous like a thick fatty matter. When cold, it is of the consistency of very solid greasy matter.

It is not always necessary to be confined to the exact proportions of paraffine, rosin, rosin oil, and tallow, or fish oil above given, for the proportions may be varied considerably with good results.

In some cases the inventor uses as much as fifty parts rosin, but it has been found that a less proportion than twenty-five per cent., by weight, of paraffine is not so reliable and valuable as a stuffing compound, as it loses its antiseptic power in a considerable degree, when mixed less than twenty-five per cent.

Leather stuffed with this compound, it is claimed, remains soft and pliable for a long time.

Williams's Compound.

Dr. Theodore D. Williams in 1870 patented a compound for stuffing and finishing leather which consists in combining neat's-foot, bank, straits, olive, fish, or horse oil with glycerine and tallow, by and through the presence of "glycerole" of egg, in quantities in accordance with the following specifications, and permitting the combining of an additional quantity of either of the aforesaid ingredients, for the purpose of adding to or reducing its common density, without dissimilating or degenerating its original and perfect chemical union. The complete union of these ingredients is dependent upon the "glycerole" of egg, which substantiates Williams's improvement, and thus brings these animal oils and fats into a perfect homogeneous mass or assemblage.

"Glycerole" of egg is prepared by adding together five parts of egg (white and yolk) and four parts of glycerine.

The following are the constituents and the respective quanti-

ties of this curriers' stuffing and finish, together with manner of putting them together: First, mix "glycerole" of egg, three parts; glycerine, five parts; second, mix neat's-foot oil, four parts; tallow (consistency of the oil), two parts. While the oil is warm (not hot) stir in the No. 1, and continue to stir until quite cold and stiff.

Dr. Williams claims that this constituent, "glycerole" of egg, is that which induces the perfect chemical union of the several ingredients by its affinity for both the oils and fats, and therein its power of suspension of same; he also claims that, to a great extent, it prevents the loss of oils and fats, which are carried into the leather by its presence and power of assimilating, while being subjected to the process of crimping, treeing, etc., in the manufacturing of leather into boots and shoes; and, furthermore, by its power of retaining large proportions of these oils and fats, it thereby remains soft and pliable, and that it is in no manner injurious to the leather.

Thayer's Compound.

This compound, which was patented by Mr. Edward S. Thayer of Salem, Mass., in 1878, is intended more particularly for stuffings, but is also adapted to other uses in treating leather.

It consists in an admixture of paraffine-wax and what is known in the United States market as "degras," the same consisting of the product proceeding from the treatment of the waters coming from the wool factories by chemical process, the same containing the "suint" extracted from the wool, and the greasy and oily matters from the soaps and oils used in those factories. This compound of paraffine-wax and degras may be used either alone for the purpose, being effective singly, or it may be used in combination with tallow or other suitable materials.

The proportions of the paraffine-wax and degras may be varied as necessity may require, but for ordinary wheel-stuffing the following is preferable: Paraffine-wax, one hundred pounds; degras, two hundred pounds. The amount of tallow, if any, used with the above will be small, and may be graded as desired.

The paraffine-wax serves as the body of the compound, to fill

the pores and harden and give substance to the leather. The degras serves as a solvent to cut the wax and as a vehicle to convey the wax into the pores. It is very penetrating, and the whole forms a compound which is very efficient for the treatment of leather.

The leather produced is of a superior quality, does not turn white or gummy, and will retain for a long time its original softness. If the finished stock is too hard, more of the degras must be used; if too soft, less.

The compound can be used advantageously as a wheel-stuffing, or as an ordinary hand-stuffing, or for the treatment of finished leather. This product (degras) is well known commercially in the United States under the name designated, and is to be distinguished from a material of the same name known in Germany and France, which consists of the residue or product proceeding from the tanning of buck, goat, or sheep skins, treated by alkali to remove the oily and gelatinous matters, and which oily and gelatinous matters, together with alkali and water, form what is known there commercially as "degras," and which is described more fully in the chapter of this work devoted to the manufacture of glove-leathers.

"B. S. Oil" for Stuffing Compounds.

Dewees and Green patented the following process by which it is claimed that leather may be rendered nearly impervious to water and left in a soft condition by use of the following cheap stuffing compound: Take B. S. oil, which is a residuum found in oil-tanks after the oil has been drawn off, and which is heavier than oil, and of different consistency at different wells or tanks.

This oil is well known in the American market as "B. S. Oil." Of this oil take a given quantity and set it on fire in the open air and let it burn until all the sulphur is consumed; the residuum will be a pure carbonaceous material.

The time required for this burning varies with the kind of oil; but the process is usually considered complete when 1 gallon of the oil thus heated weighs about 7 pounds and 7 ounces.

After the oil has been thus treated there is added, to each 1

gallon of the refined oil, 7 pounds of tallow. These proportions may be varied to adapt the stuffing compound to thin and thick leather, and to different temperatures.

List of all Patents for Compounds for Stuffing Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
12,368	Feb. 6, 1855.	L. W. Fiske,	Louisville, Ky.
14,832	May 6, 1856.	J. Rose,	Newark, N. J.
15,499	Aug. 5, 1856.	F. A. White,	Roxbury, Mass.
44,025	Aug. 30, 1864.	A. Taw,	Philadelphia, Pa.
54,587	May 8, 1866.	M. W. Page,	Franklin, N. H.
55,426	June 5, 1866.	C. L. Morehouse,	Cleveland, Ohio.
55,715	July 19, 1866.	J. A. Roth,	Philadelphia, Pa.
57,165	Aug. 14, 1866.	T. McDonald,	Roxbury, Mass.
61,379	Jan. 22, 1867.	R. Andrews,	Milwaukee, Wis.
90,333	May 25, 1869.	R. Andrews,	Milwaukee, Wis.
100,652	Mar. 8, 1870.	J. Merrill,	Boston, Mass.
107,579	Sept. 20, 1870.	T. D. Williams,	Chicago, Ill.
160,440	Mar. 2, 1875.	H. Klemm and C. Klemm,	Pfullingen, Germany.
204,398	May 28, 1878.	E. S. Thayer,	Salem, Mass.
209,800	Nov. 12, 1878.	M. L. Dewees and W. W. Green,	Elk City, Pa. Cambridgeborough, Pa.

List of all Patents for Compounds for Currying[1] *Leather, issued by the Government of the United States of America, from* 1790 *to* 1883 *inclusive.*

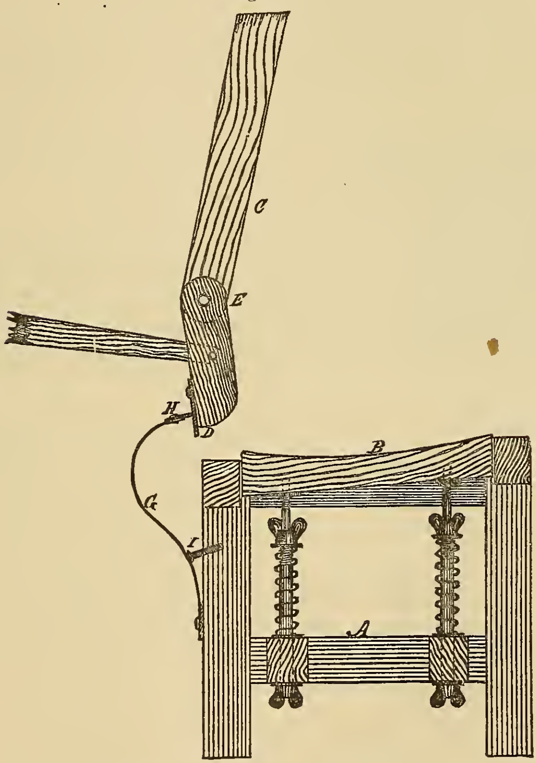
No.	Date.	Inventor.	Residence.
866	Aug. 1, 1838.	A. Hickman and E. L. Davenport,	Abingdon, Va.
54,587	May 8, 1866.	M. W. Page,	Franklin, N. H.
84,096	Nov. 17, 1868.	A. Doepp,	Newark, N. J.
147,847	Feb. 24, 1874.	Wm. Kinsey,	Cincinnati, O.
160,841	Mar. 16, 1875.	J. H. Radey,	Philadelphia Pa.
160,902	Mar. 16, 1875.	R. Hart,	Gloversville, N. Y.
161,203	Mar. 23, 1879.	J. Carmody,	New York, N. Y.
167,142	Aug. 24, 1875.	P. Ware, Jr.,	Boston, Mass.
171,719	Jan. 4, 1876.	E. F. Dietsrich,	Philadelphia, Pa.
182,368	Sept. 19, 1876.	J. Kent,	Gloversville, N. Y.
203,498	May 7, 1873.	N. Quinland and J. H. Quinland, Jr.,	Glens Falls, N. Y.
222,944	Dec. 23, 1879.	E. W. Phillips,	Waverly, N. Y.
225,772	Mar. 23, 1880.	M. B. Tice,	Newark, N. J.

[1] See also list of compounds for stuffing leather.

Section III. Machine for Removing Grease from Leather.

The machine for removing grease from leather, which was invented in 1872 by William A. Perkins, of Salem, Mass., is shown in Fig. 164, and is an improvement on the machine, for this purpose patented by J. T. Barnstead in 1870, in which a knife is made to reciprocate over a suitable bed, and a brush is

Fig. 164.



used to remove the grease which is attached to the knife at each reciprocation. This brush is found in some cases to be inoperative and liable to objections which Perkins's invention is designed to remove. It is important that the knife which scrapes the grease from the leather should be properly cleaned at each stroke, or the accumulation of grease on the knife is

liable to drop on the leather and soil it. To accomplish this result Perkins uses in place of the brush in Barnstead's machine a metal plate, which may be mounted in the same manner as in Barnstead's machine; but the arrangement shown in Fig. 164 and described is preferable.

Fig. 164 shows a vertical section of Perkins's Machine.

A represents the frame of the machine; *B*, the adjustable bed; *C*, the pendulum-arm, to which is attached the knife *D*. The pendulum-arm is made in two parts and jointed at *E* so that the knife is raised clear of the leather at the return stroke. Motion is communicated to the pendulum through the connecting-rod *F*. On the back side of the frame *A* is bolted a curved spring, *G*, which is made preferably of steel. To this spring is attached the scraper *H*, in the position shown. The scraper *H* is made of a thin narrow plate of steel or iron.

At each reciprocation of the knife *D* over the leather a quantity of grease is removed, which attaches itself to the knife. As the knife passes over the bed it leaves the leather and comes in contact with the scraper *H*, which removes the grease from the knife, and it drops into a receptacle placed for the purpose clear of the frame *A*.

Fig. 164 shows the knife and scraper in the position just described.

The distance of the scraper *H* from the knife is adjusted by means of the screw *I*.

List of all Patents for Machines for Removing Grease from Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
101,081 Reissue 4,258	Mar. 22, 1870. Feb. 14, 1871.	J. T. Barnstead,	Peabody, Mass.
105,506	July 19, 1870.	J. Starratt,	Salem, Mass.
122,130	Dec. 26, 1871.	J. Perkins and G. L. Newcomb,	Peabody, Mass.
123,643	Feb. 13, 1872.	W. A. Perkins,	Salem, Mass.
252,559	Jan. 17, 1882.	E. V. Whitaker and J. Hull,	Gloversville, N. Y.

CHAPTER XXIII.

Whitening Leather.

The side having been stuffed and next "set out" (which latter operation can be performed for calf-skins or the heavier grades of upper leather by the Lockwood machine shown in Figs. 138 to 140, or the Fitzhenry machine shown in Figs. 147 to 151), the next step in the process of manufacturing upper leather is that of whitening. This is usually accomplished by one of three ways: The leather may be placed on a table and whitened with a slicker, or cut over with a currier's knife or a beam, or the whitening can be performed by machinery.

Fig. 165.

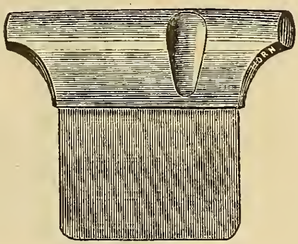


Fig. 165 shows the French pattern of whitening slicker, which is the kind usually employed in this country. The blades, which are of cast steel, are usually of two degrees of hardness; the bright blade compares in temper with a medium hard blade, the half polished are softer, being of a lower temper.

Fig. 166 shows the form of beam now generally employed in currying shops. The beam-bed and face are adjustable by means of screws, and the beam may be elevated or lowered at any necessary height to suit the convenience and comfort of the workman. The faces may be either of lignum vitæ or of glass.

There is a great variety in the construction of currier's knives; but the form shown in Fig. 167 is the most common. The blades are screwed in the brass jaws by three screws from each side, thus securing equal strength. The blades for the currier's knives are made from hammered steel, and are either

bright or unpolished, and vary from seven-eighths to two inches in width, and those kept in stock by the manufacturers are

Fig. 166.

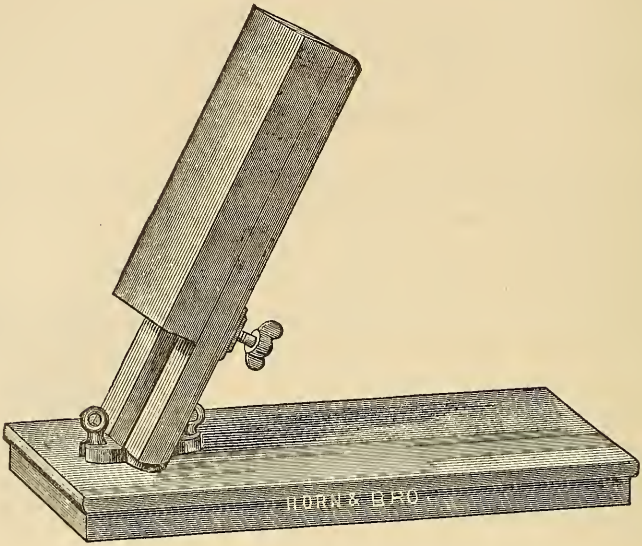
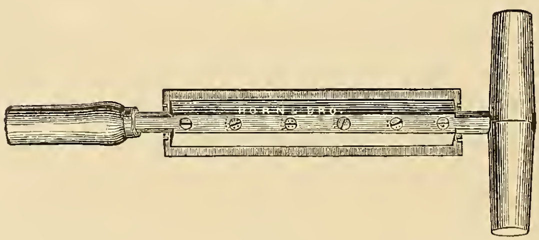


Fig. 167.



made in nineteen and twenty gauge; but other gauges are manufactured to order.

Clements's Leather-Whitening Machine.

The leather-whitening machine shown in Figs. 168 to 172 is the invention of John E. Clements, and it is an improvement on the leather whitener patented by Enos and Clements in 1881.

Fig. 168 is a plan view of the machine. Fig. 169 is an end

view. Fig. 170 is a cross-section on line x x of Figs. 168 and 171. Fig. 171 is a longitudinal section on line y y of Fig. 168, and Fig. 172 is a detail section of the thrust-box.

Fig. 168.

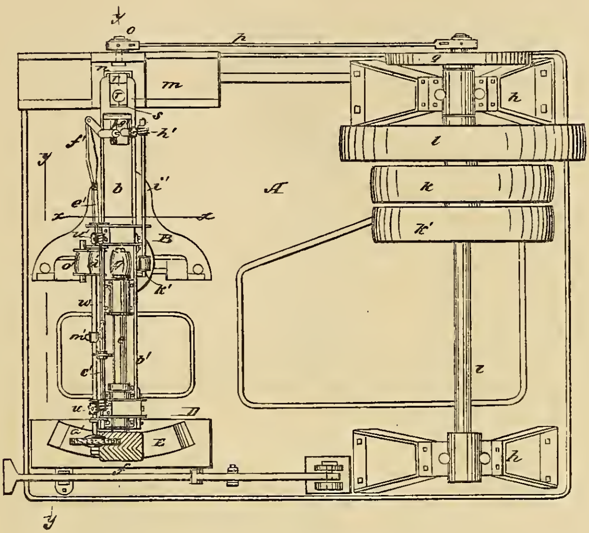
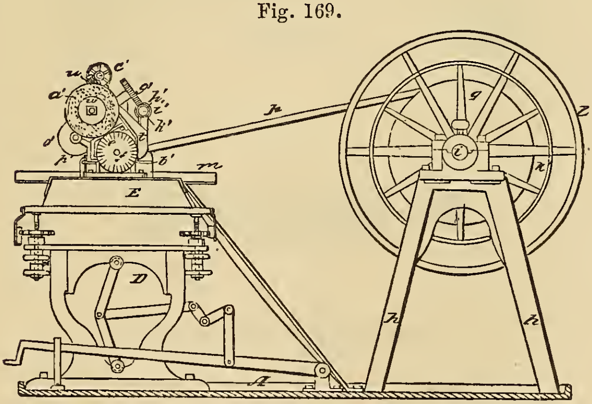


Fig. 169.



A is the bed-plate. *B* is a stand supporting the rocking hub *C* by its spindle *a*. *D* is a stand carrying feed-bed *E*. *h h* are stands supporting a horizontal shaft, *i*, which carries fast and

loose pulleys $k\ k'$ for the belt from the main driving-shaft and a pulley, l, for a belt to drive an overhead counter-shaft.

Fig. 170.

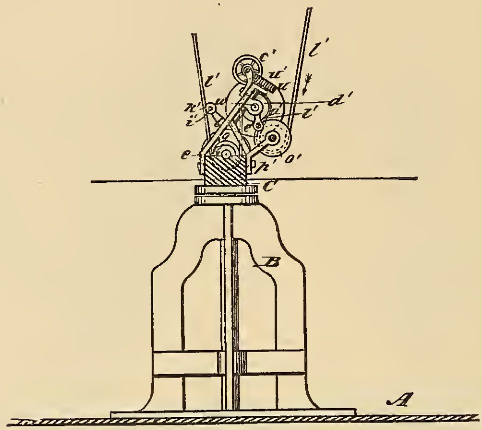


Fig. 171.

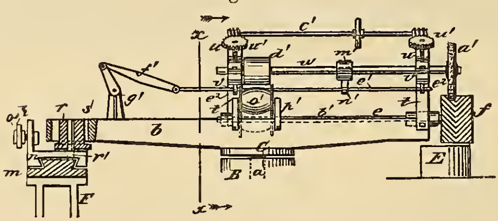
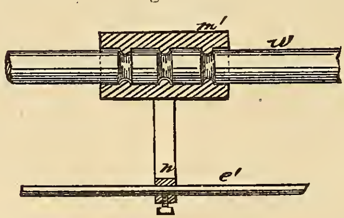


Fig. 172.



$b\ b'$ are arms projecting from hub C. e is the cutter-shaft sustained in suitable bearings on the arm b', and carrying the cutter-head f above bed E, and also provided with a pulley, g.

F is a stand supporting a horizontal slide-way, m, at the end

of arm *b*, and *n* is a slide-block fitted for movement on the slideway.

o is a wrist-pin on the slide-block, to which is connected a rod, *p*, from a crank-wheel, *q*, on shaft *i*.

r is a gudgeon attached to slide *n* by a pin, *r′*, and fitting a slot, *s*, in the end of the arm *b* of the hub *C*, so that by movement of the slide the hub is rocked, the movement of the gudgeon in slot *S*, allowing for change of position.

The grinder *a′* is an emery-wheel, bearing on the cutters at one side of the head, the intention being to have continuous contact which is regulated, as the grinder wears, by turning the screws *u* to force shaft *w* downward. A worm-shaft, *c′*, carried by brackets *t* and engaging worm-wheels *u′* on the screws, is used for simultaneous movement of the screws.

On the grinder shaft *w* is a pulley, *d′*, connected thereto by a pin and key-slot, that allows endwise movement of the shaft. *e′* is a rod sustained in guides e^2 on boxes *v*, and connected by a rod, *f′*, to the crank-arm of a short cross-shaft, *g′*, that is sustained on the rocking-arm *b*. The shaft *g′* is connected by a worm and pinion at *h′* with a shaft, *i′*, that extends to hub *C*, where it has a pulley, *k′*, turned by contact with the driving-belt *l′* of the cutter shaft, so that the rod *e′* is given an endwise reciprocation. On the grinder-shaft is a thrust-box, *m′* (shown most clearly in Fig. 172), which has internal flanges taking into grooves on the shaft, and has also an apertured flange, *n′*, clamped on rod *e′* by a set-screw, whereby the grinder-shaft is reciprocated with the rod. By these devices the grinder is moved back and over the cutters from one side of the cutter-head to the other. The same movement may be obtained by connecting the outer end of reciprocating rod direct to grinder-flanges by means of a fork. In this case the grinder-shaft does not reciprocate, but same motion is communicated to grinder and flanges which reciprocate upon the end of shaft having spline, key, or feather set into it, giving the grinder a rotary movement.

The cutter and grinder are driven by the belt *l′* from the overhead counter-shaft, which, as before mentioned, is driven from the shaft *i*. The belt *l′* passes first beneath a tightening-pulley, *o′*, that is hung on a bracket, *p′*, then upward and over

the pulley d' of the grinder-shaft, and then beneath pulley g of the cutter-shaft, as shown most clearly in Fig. 170. The driving-belt thus extends at right angles, or nearly so, to the plane in which the hub C rocks, and is slightly twisted by the rocking movement. That arrangement is more reliable, because the belt remains centred on the pulleys, and is not shifted from side to side, as is the case with a belt extending in the plane of vibration. The bracket p' of the tightener-pulley o' is attached to hub C by screws passing through slots in the bracket, so that adjustment can be readily made.

In place of the cutter-head, a smooth or fluted roller, hollow and heated by steam, may be substituted, and the machine then used for ironing and glossing leather.

Smith's Leather-Whitening and Buffing Machine.

The machine for whitening and buffing leather invented by Oliver C. Smith is shown in Figs. 173 to 176.

Fig. 173.

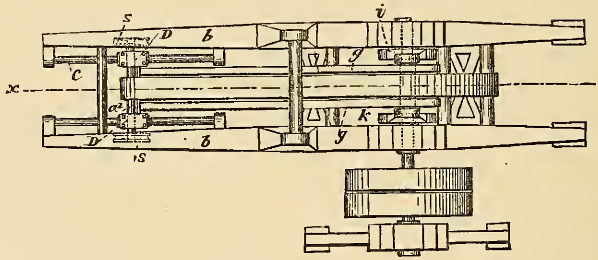


Fig. 174.

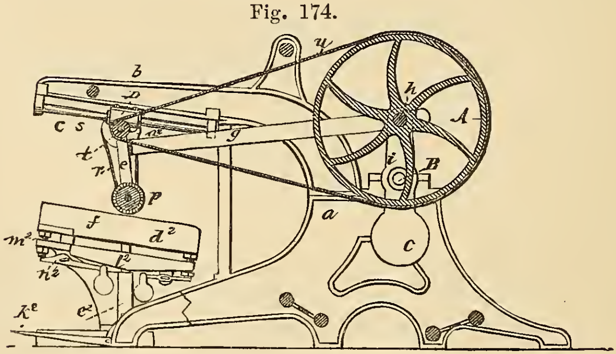


Fig. 175.

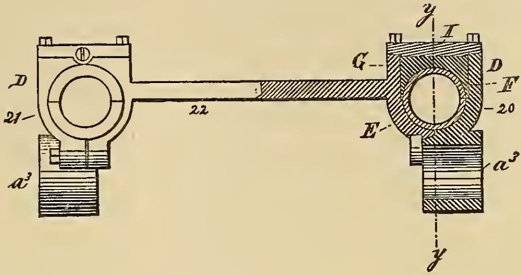
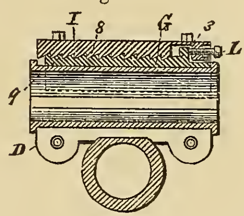


Figure 173 represents, in top view, a machine embodying Smith's invention; Fig. 174, a longitudinal vertical section thereof on the dotted line $x\ x$, the table or bed being shown in elevation. Fig. 175 is an enlarged detail, partially in section, showing the boxes of the sliding frame; and Fig. 176, a section of Fig. 175 on the dotted line $y\ y$.

Fig. 176.



In this invention the pulley A is fixed directly upon the crank-pin h, joining the two cranks $i\ k$, projected from shaft B. The weight of the pulley A is counterbalanced by the weights C, one on each crank. The belt u on this large fixed pulley A is extended over the pulley t on the shaft a^2 at the upper end of the usual swinging frame, and rotates the said shaft, together with its pulleys s, which by small belts r revolve the rotary cylinder or tool p in the usual manner as the link g, herein made double, reciprocates the carriage D on the guide-rods c. This carriage is composed of yokes 20, 21, connected by a bar, 22, the yokes having depending from them bearings a^3 to receive the shaft a^2, which turns in the said bearings. The boxes which run on the guide-rods c have Babbitt or other linings, $E\ F$. Upon the lining F, the inventor has placed an adjusting-wedge, G, provided with one or more inclined teeth or wedging-surfaces, 9, and above the adjusting-wedge he has placed a cap, I, having at its under side one or more opposed teeth or inclines, 8.

List of all Patents for Currier's Slickers, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
20,098	April 27, 1858.	H. H. Sultzbach,	Marietta, Pa.
52,491	Feb. 6, 1866.	J. Hankey,	North Cambridge, Mass.
62,064	Feb. 12, 1867.	D. Peters and J. W. Pauly,	Keokuk, Ia.
42,397	April 19, 1864.	D. Peters and W. D. Wilson,	Keokuk, Ia.
115,709	June 6, 1871.	G. T. Collins,	North Eastham, Mass.
127,756	June 11, 1872.	G. B. Fowle,	Boston, Mass.

List of all Patents for Currier's Knives, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
20,911	July 13, 1858.	J. B. Wentworth,	Lynn, Mass.
28,594	June 5, 1860.	W. P. Moses,	Exeter, N. H.
37,285	Jan. 6, 1863.	G. Featherston,	Ausable Forks, N. Y.
51,942	Jan. 9, 1866.	J. P. Hawks,	Troy, N. Y.
94,197	Aug. 31, 1869.	L. A. Gignac,	Troy, N. Y.
111,901	Feb. 21, 1871.	J. T. Barnstead,	Peabody, Mass.
137,671	April 8, 1873.	C. A. Gardner and J. A. Enos,	Peabody, Mass.
149,563	April 14, 1874.	A. H. Beschormann,	San Francisco, Cal.
193,806	Aug. 7, 1877.	R. E. Cherington,	Holyoke, Mass.
208,593	Oct. 1, 1878.	T. Hansen and G. H. Weifenbach,	Racine, Wis.
227,597	May 11, 1880.	J. Tuggle,	New Middleton, Tenn.

Machines for Sharpening Currier's Knives.

No.	Date.	Inventor.	Residence.
1,064	Jan. 8, 1839.	W. Eagleston,	Troy, N. Y.

List of all Patents for Machines for Whitening, Buffing, and Shaving Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
732	May 10, 1838.	S. Graham,	Roxbury, Mass.
26,641	June 5, 1860.	J. Turner,	Cambridgeport, Mass.
63,191	Mar. 26, 1867.	T. F. Weston,	Salem, Mass.
65,919	June 18, 1867.	C. Korn,	Wurtsborough, N. Y.
77,025	April 21, 1868.	L. B. Fox,	Williamsport, Pa.
85,030	Dec. 15, 1868.	C. Schmitz,	Philadelphia, Pa.
89,789	May 4, 1869.	A. W. Pratt,	Salem, Mass.
Reissue 4,534	Aug. 29, 1871.		

No.	Date.	Inventor.	Residence.
138,874	May 13, 1873.	J. A. Enos,	Peabody, Mass.
150,285	April 28, 1874.	J. McCaller,	Salem, Mass.
157,442	Dec. 8, 1874.	J. E. Fisk,	Salem, Mass.
157,939	Dec. 22, 1874.	O. C. Smith,	Ipswich, Mass.
191,173	May 22, 1877.	W. A. Perkins,	Salem, Mass.
191,400	May 29, 1877.	J. G. Buzzell,	Lynn, Mass.
202,226	April 9, 1878.	J. G. Buzzell,	Lynn, Mass.
247,014	Sept. 13, 1881.	J. E. Clement and J. A. Enos,	Peabody, Mass.
248,290	Oct. 18, 1881.	P. De Chamberet,	Paris, France.
248,518	Oct. 18, 1881.	O. C. Smith,	Ipswich, Mass.
252,928	Jan. 31, 1882.	J. G. Buzzell,	Lynn, Mass.
259,497	June 13, 1882.	J. E. Clement,	Peabody, Mass.
261,309	July 18, 1882.	J. E. Clement,	Peabody, Mass.

CHAPTER XXIV.

BOARDING AND GRAINING BY MACHINERY.

Following the whitening the next step in the production of upper leather is that of "stoning out," and while this is sometimes done by hand, it is almost generally accomplished by machinery, which is usually a "jack," very similar in many points of construction to the machines used for polishing and pebbling leather.

If after "stoning out" the leather should require softening it is "boarded," and when this is done by hand it is a tedious and laborious operation; but in this as in other branches of leather manufacture machinery has come to the aid of the workman, and now the softening and graining can be accomplished most satisfactorily, and at the expenditure of but little power, and with but little effort on the part of the operator compared to the old way.

Before the introduction of boarding and graining machines, this portion of the finishing suffered its full share from the neglect or incompetence of the workman, and manufacturers were compelled to sell their leather at considerably less per foot

than they might have done with this department well looked after.

But now the upper leather when boarded and grained on the best of these machines has that peculiarly soft and velvety feeling which formerly distinguished imported stock, and which is now common in the leather made by us both for home consumption and for our export trade. The armboard in common use is shown in Fig. 243, and it continues to be employed principally for Morocco and other light leathers.

Coogan's Boarding and Graining Machine.

Fig. 177 shows a perspective view of Coogan's Machine for boarding and graining leather.

The two rollers *A* and *B*, Fig. 177, may be of cork or a composition covering, which with proper usage will last for one year or more, and when worn they can be renewed at but a trifling expense when compared with cork rollers. The rollers are each about eight inches in diameter, and placed one above another, and run on iron shafts, set in a frame at either end, but so that the upper roller can be raised or lowered at pleasure and adjusted at any desired distance from the lower one and held permanently in position by means of the screws *F*.

The upper roller is about four and one-half feet long, but the lower one is somewhat longer, forming a table, and the frame in which the shafts of these cylinders revolve is about seven feet long.

Opposite the top of the lower roller *B*, extending its full length, and arranged so that by a slight pressure on the treadle *D* underneath, or by pushing with the hand, it can be brought to bear directly in the centre between the two rollers, is a thin steel feed-plate *C*.

The rollers revolve in the same direction, so that by placing the leather on the feed-board *C*, with one end or side just over the edge, and moving it against the revolving rollers, the upper roller carries it in, and the lower roller carries it out, turning it sharply under the edge of the plate, and almost instantaneously boarding a side or whole hide, the time required for the opera-

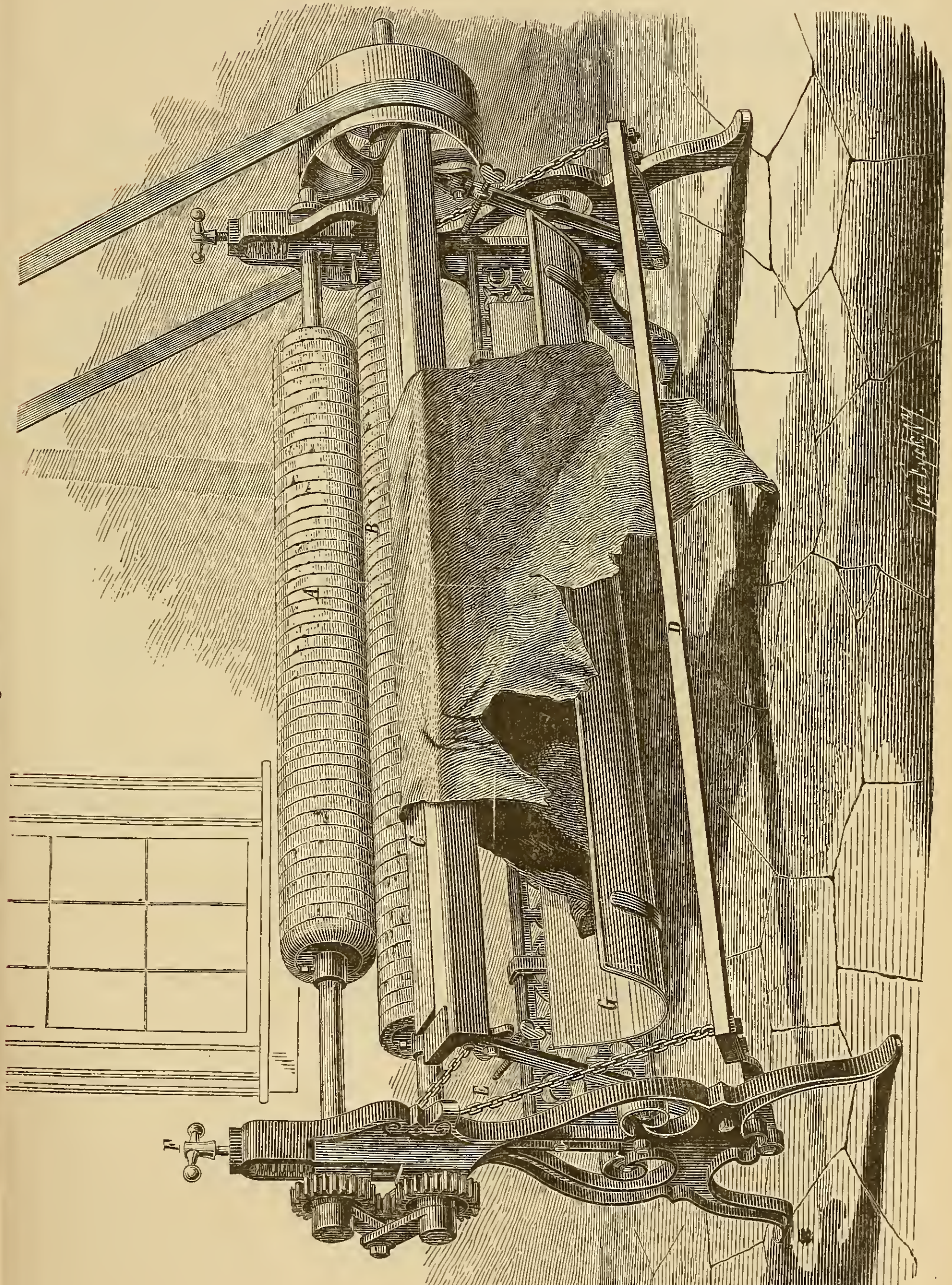


Fig. 177.

tion being about one-tenth of that which would be required to perform the same work by hand.

Hovey's Boarding and Graining Machine.

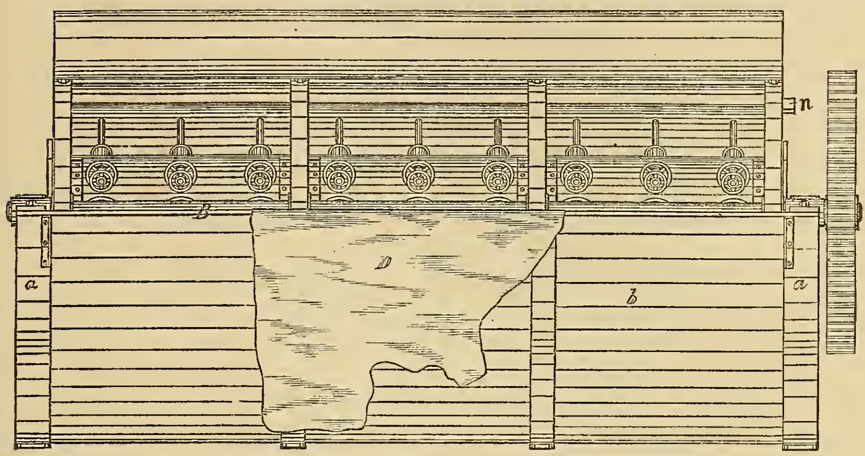
Hovey's machine for boarding and graining is shown in Figs. 178 to 182, and the invention consists essentially of a stationary concave bed having an elastic or yielding surface on its inside and a reciprocating worker movable on an axis, and provided with a yielding convex surface adapted to work within the concave bed, also of a revolving brush-roller located in bearings attached to the worker, a little in advance of the holding device which will be mentioned, for the purpose of properly laying and keeping the leather smooth and to prevent it from wrinkling during the process of boarding or graining it.

There is an automatic device for locking and holding the leather attached to the forward end of the worker until the boarding or graining is accomplished. The inventor also uses a self-acting reversing device for automatically reversing the motion of the reciprocating worker during the operation of the machine. The reciprocating worker is provided with an adjustable pressure-regulating device, by means of which the surface of the worker may be adjusted more or less in or out, as may be required, for regulating the pressure on the leather between the worker and the concave bed, according to the thickness of the leather that is operated upon. The concave bed and its reciprocating worker are of a sufficient size to take in a whole side of leather at one time, so that the soft and thin parts of the side may receive the same relative pressure as the thick parts and thus grain the side equally all over.

Figure 178 represents a front elevation of Hovey's machine. Fig. 179 represents an end elevation of the same, showing the worker in the act of drawing the leather into and laying it inside of the concave yielding bed. Fig. 180 represents an end view of the machine, showing the motion of the worker, as reversed, in the act of boarding or graining the leather. Fig. 181 represents an end view, seen from *X* in Fig. 178; and Fig. 182 represents a front elevation of the automatic reversing device for the reciprocating worker.

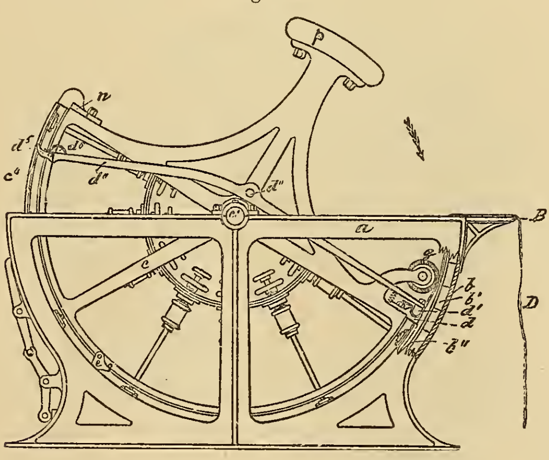
In using the machine one end of the leather to be grained or boarded is inserted between the bars *d* and *d′*, which are made

Fig. 178.



automatically to close upon each other and to hold the leather firmly between them, and the reciprocating worker then pro-

Fig. 179.



ceeds in the direction shown by the arrow in Fig. 181. The reciprocating worker continues in the same direction to draw

and lay the leather D within the concave bed in a manner as shown in Fig. 179, and continues in the direction shown by

Fig. 180.

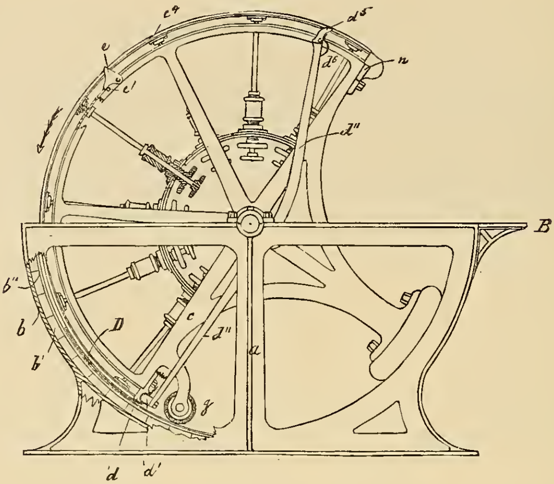
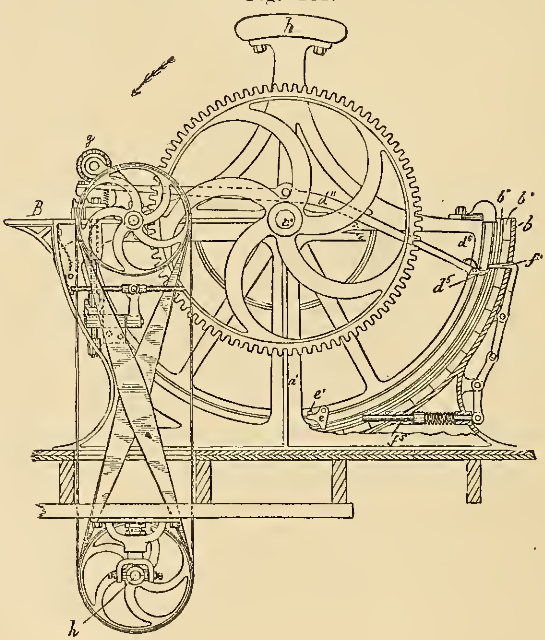
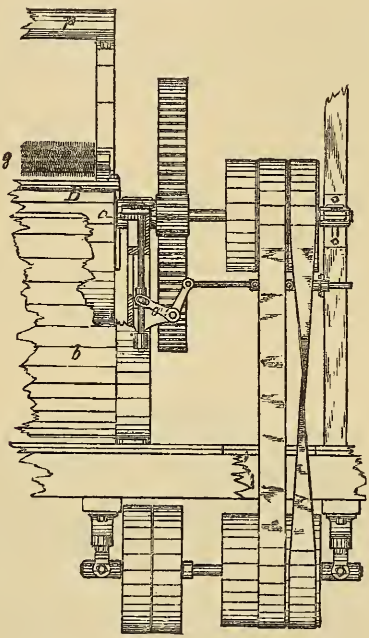


Fig. 181.



arrows in Fig. 179 until its projection n hits the projection o on the belt-shipper, when the motion of the worker is reversed, as shown by arrow in Fig. 180, and causing the leather D to be grained or boarded by being doubled upon itself, and, as it were, rolled between the elastic concave bed b'' and the elastic cover-

Fig. 182.



ing c^4 in a manner closely resembling the manner of graining or boarding by hand tools. The worker continues to move in the direction shown by arrow in Fig. 180 until the reciprocating worker has completed nearly a revolution around its axis, and until the projection n again comes in contact with the reversing-projection o, when its motion is reversed to that shown by the arrow in Figs. 179 and 181, and during this motion of the worker the hinged foot d^5 on the end of the arm or lever d'' is brought in contact with the inward projection f', causing the holding device d d' to open to enable the finished leather to be taken away and a new side inserted, which is automatically

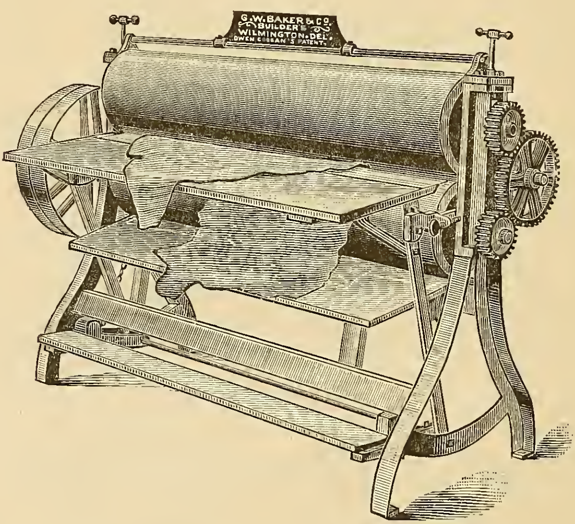
clamped and held firmly between the parts $d\,d'$ as soon as the dog or tooth e comes in contact with the sliding rod f^5. The hinged foot d^5 will pass freely by the lever-projection f' when the worker is moved in the direction of the arrow shown in Fig. 180, and when the worker is in such motion the dog or tooth e will also pass freely by the inner end of the sliding rod f^5.

In the drawings, a and a' represent the ends or frames of the machine, between which is secured the concave bed, composed of an outer concave metallic frame, b, wood lining b', and yielding elastic surface b'', made of cork, India-rubber, or similar elastic material; p represents the counterweight to the reciprocating worker.

Machine for Boarding and Graining Morocco.

The machine shown in Fig. 183 is for boarding and graining Morocco, and is an improvement made by G. W. Baker, of

Fig. 183.



Wilmington, Del., on the machine invented by Owen Coogan, which is shown in Fig. 177.

This machine will soften light leathers in a highly satisfactory

manner, the "bone" all being taken out, and the machine will also "spring up" the pebble grain of Morocco equally as well as hand work.

The machine is simple in its construction and operation. Two rollers, twelve inches in diameter, covered with composition, revolve in the same direction, and adhere firmly to the skin.

The table is connected with the treadle-motion on which the skin is placed with the grain side down for softening, and put in with the shanks parallel with the steel blade fastened to the edge of the movable table. The operator, by a slight pressure of the foot, pushes the blade between the running rollers, the skin being carried around the edge of the plate by the rollers, the top one carrying it in, while the lower one carries it out. This operation bites the skins over the edge of the plate, giving the same breaking action as the cork-hand boarding, only that it takes one-half of the skin in, which runs rapidly through the machine; it is then reversed and the other part run through. The softness depends entirely on the number of times it passes through the machine, but ordinarily, twice is sufficient.

In graining, the skin is reversed; instead of putting the grain side down, put it up.

The machine runs slowly, about forty-five revolutions per minute, and requires a little less than one-half horse-power, does its work cheaply and well, and is worthy of the attention of the Morocco trade.

List of all Patents for Machines for Boarding and Graining Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	Mar. 25, 1835.	C. Bassett,	Boston, Mass.
14,211	Feb. 5, 1856.	J. B. Wentworth,	
15,807	Sept. 30, 1856.	J. Greenleaf,	
48,971	July 25, 1865.	W. H. Moore,	Salem, Mass.
54,360	May 1, 1866.	G. R. Johnson,	Wilmington, Del.
54,821	May 15, 1866.	J. Parker,	Woburn, Mass.
62,514	Feb. 26, 1867.	J. E. Wiggin,	Stoneham, Mass.
94,196	Aug. 31, 1869.	L. A. Gignac,	Troy, N. Y.
108,319	Oct. 13, 1870.	M. B. Bishop,	Whitingham, Vt.

No.	Date.	Inventor.	Residence.
110,944	Jan. 10, 1871.	U. R. Williams and Wm. P. Martin,	Salem, Mass.
119,743	Oct. 10, 1871.	O. Coogan,	Pittsfield, Mass.
126,105 Reissue 8,088	April 23, 1872. Feb. 19, 1878.	L. Townsend,	Terra Haute, Ind.
135,350	Jan. 28, 1873.	N. O. Lownsberry,	Wilmington, Del.
138,133	April 22, 1873.	O. Coogan,	Pittsfield, Mass.
140,633	July 8, 1873.	N. O. Lownsberry,	Wilmington, Del.
157,632	Dec. 8, 1874.	P. O'Brien,	Boston, Mass.
161,269	Mar. 23, 1875.	A. W. Perrin,	New York, N. Y.
168,497	Oct. 5, 1875.	H. Howson,	Philadelphia, Pa.
176,535	April 25, 1876.	L. R. Jenkins,	Philadelphia, Pa.
202,414	April 16, 1878.	W. Coupe,	South Attleborough, Mass.
218,908	Aug. 26, 1879.	L. P. Mason,	Salem, Mass.
241,303	May 10, 1881.	W. Coupe,	South Attleborough, Mass.
248,220	Oct. 11, 1881.	A. Schray and A. Barentigam,	New Albany, Ind.
253,533	Feb. 14, 1882.	J. H. Hovey,	Woburn, Mass.

CHAPTER XXV.

BLACKING LEATHER.

Section I. Blacking and "Smutting" Appliances.

The side of leather having passed through the previously described operations and been last boarded, is now in the state for blacking, and this is performed both by hand and machinery. It is thought by manufacturers that the hand process is preferable for the heavy grades of upper leather; but upon what ground it is not plain, as some of the machines constructed for this purpose are models of mechanism, and perform the work much more economically and thoroughly than is usually done by the hand process.

Figs. 184 and 185 show the two forms of blacking brushes in common use, and they are made both soft and stiff, the best quality are extra copper-wired, and have all bristles. The

oval form is always made with a strap; but the round form have either handles or straps. Both brushes are made in first

Fig. 184.

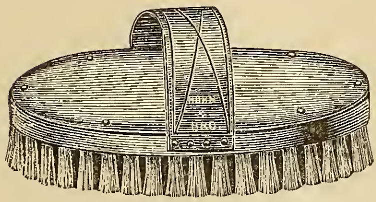
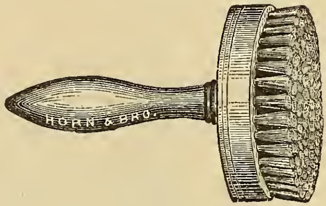


Fig. 185.



and second qualities; but it is economy to purchase the best grade, as the extra wear more than compensates for the small difference in price.

Batchelder's Leather Blacking, Coloring, and Dressing Machine.

Figs. 186 to 195 show the leather blacking, coloring, and dressing machine patented by Batchelder.

Fig. 186.

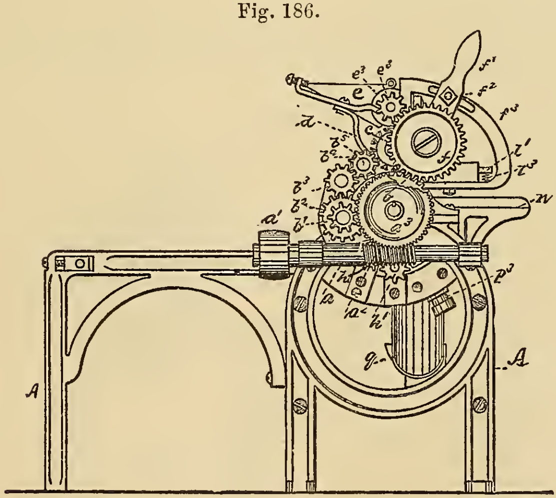
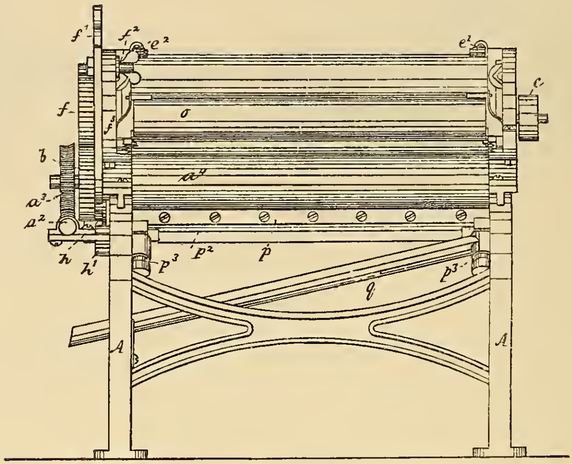


Figure 186 is a left-hand-side elevation of a machine embodying Batchelder's invention; Fig. 187, a front view thereof, with the table n omitted; Fig. 188, a longitudinal vertical section of

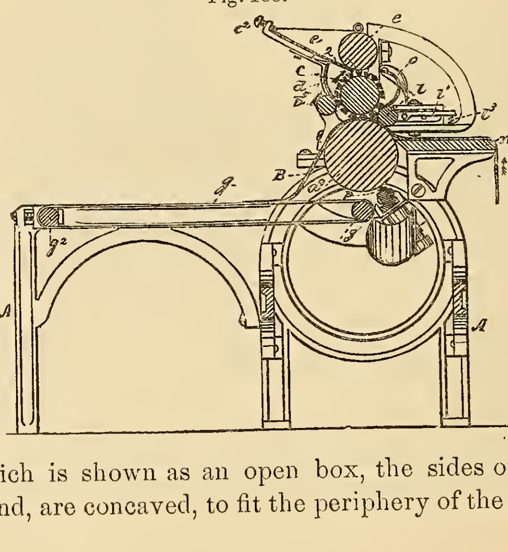
Fig. 187; Fig. 189, an enlarged detail to be referred to; Fig. 190, a detail in top view of Fig. 189, with the brush *c* omitted; and Fig. 191 is a modification to which reference will be made.

Fig. 187.



The blacking or liquid dressing, or material to be applied to the upper surface of the hide or skin *B*, is placed in the receptacle *e*, which is shown as an open box, the sides of which, at its lower end, are concaved, to fit the periphery of the receptacle-

Fig. 188.



roller e', which may be made to travel near the straight lower edge, 2, of the bottom of receptacle by means of the adjusting screws e^2, the amount of space between the edge of the bottom

Fig. 189.

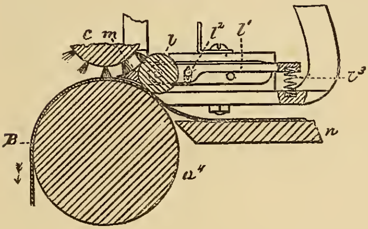
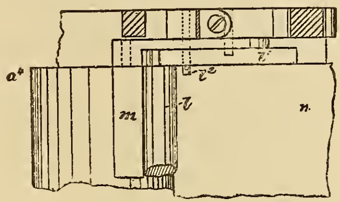
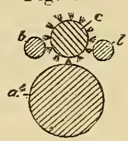


Fig. 190.



of the receptacle e and the roller e' determining the amount of blacking or dressing to be delivered to the brush c. The roller e' may be driven more or less rapidly to carry or deliver more or less blacking or dressing to the brush c. This may be done by changing the size of the gear e^3 on the journal of the roller e', the toothed speed-wheel f, which engages the gear e^3 and drives the roller e', being mounted on a stud of an adjustable carrier, f', provided with a locking device, f^2, to engage an arch, f^3, and hold the carrier in proper position.

Fig. 191.



It is preferable to slightly groove, flute, or pit the roller e', to enable it to take up a greater quantity of blacking or dressing. The hide or skin as it leaves the supporting-surface a^4 is delivered upon an endless belt or moving bed, g, shown as composed of cords or tapes extended about rollers g' g^2, the one g' being driven positively from the toothed wheel b by the intermediate worm, h, which engages the pinion h' at the end of the shaft g'. The tanned hide or skin to be dressed is introduced between the supporting-surface a^4 and roller or brush c under a roller, l, which, as clearly shown in Figs. 188 and 189, has its journals mounted on levers or arms l', pivoted at l^2 and acted upon by springs l^3, to keep the roller depressed upon the hide or skin to properly hold it. The front ends of the levers or arms l' are joined to a holding-bar, m, which is of a shape to fit the space between the brush c, the support a^4, and roller l. The under

side of this holding-bar (see Fig. 189) is so shaped, curved, and located with relation to the surfaces of the roller l and the supporting-surface a^4 as not to bear upon the hide or skin until after the passage of the edges of the same beyond the nip of the roller l, the holding-bar being devised to act upon and hold the end of the hide or skin, after passing beyond the nip of roller l (the latter then dropping), and prevent the hide or skin being drawn in too rapidly. In front of the apparatus there is placed a table, n.

In some instances and for some classes of work the inventor modifies the machine so far described, as represented in Fig. 191, and where there is shown the roller l as elevated considerably above the position shown for it in Figs. 188 and 189, and in such position there will be left sufficient space to permit the operator to retain hold of and control the position and movement of the hide or skin being acted upon by the brush or roller c, and in such case also the holding-bar m is omitted.

To prevent the blacking or dressing being thrown from the brush or roller c toward the front of the machine there is provided the auxiliary spatter-guard o. The roller l and the holder m, when used, also serve to prevent the blacking or liquid dressing from being thrown out at the front of the machine. The supporting-surface a^4 and brush e are as long as the maximum width of the hide or skin to be blacked or dressed; but as the hides or skins being finished or dressed are always different, both as to width and outline at their edges, it results that the brush c always applies blacking or dressing to more or less of the surface a^4.

The blacking or dressing applied to the surface a^4 must all be removed and the surface be left clean so as not to apply blacking or dressing to the under side of the hide or skin as it comes in contact with it. To do this the inventor has provided a wiper or cleaner, p (shown clearly in Figs. 187 and 188), as a strip of flexible material held by a suitable adjustable bar, p^2, so that the edge of the wiper or cleaner may be pressed with more or less force against the surface a^4, the degree of its pressure being preferably regulated by adjusting-screws p^3. The material wiped or scraped from the surface a^4 drops into the

trough q and passes therefrom into a suitable pail or bucket to be rinsed, if desired.

By driving the brush-roller c and the supporting-surface a^4 independently, the inventor is enabled to rotate either at any desired speed, and thus rub the blacking, coloring, or dressing matter more or less into the surface of the hide or skin.

The bearings for the brush c and roller e' will preferably be made adjustable vertically to accommodate for the thickness of the leather and compensate for wear.

Batchelder in 1883 patented an improvement on the machine just described, which improvement is shown in Figs. 192 to 195. In the machine described in Figs. 186 to 191, the brush-roller which applied the blacking or the liquid dressing to the leather on a rotating supporting surface or roll had its bristles set radial; but with such a brush the distribution of the blacking is not so uniform and thorough as is desirable, so, to cause the brush to apply the blacking to every minute part of the face of the leather being blacked or treated, Batchelder has inclined the bristles of the alternate rows of bristles of the brush in different directions, those of one row inclining toward one end of the cylinder and those of the next alternate row toward the opposite end of the cylinder, so that the ends of the bristles, besides travelling over the leather in the direction of rotation of the brush-roller, also, when in contact with the leather, spring or yield in opposite directions, the free ends of the bristles of alternate rows moving in opposite directions longitudinally as compared with the axis of the brush-roll, thus working the blacking backward and forward across the leather, as well as in the direction of its movement over the supporting-surface. In this way every particle of the upper side of the leather is effectually blacked and streaks are effectually prevented.

Fig. 192 represents in section a sufficient portion of a leather blacking or dressing machine to illustrate the present improvement; Fig. 193, an end view of the brush-roller on a larger scale; and Figs. 194 and 195 two partial sections thereof in the dotted lines x and y.

The supporting bed a^4, color-roller e', deflector d, spatter-roller b', and roller i are as in the machine shown in Figs. 186 to 191.

The roller *c*, which applies blacking to the leather *B*, has its alternate longitudinal rows of bristles *a b* inclined in opposite directions, those of one row being as in Fig. 194, and those of the next row as in Fig. 195, so that as the bristles yield on com-

Fig. 192.

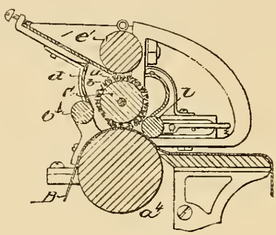


Fig. 193.

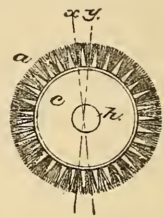


Fig. 194.

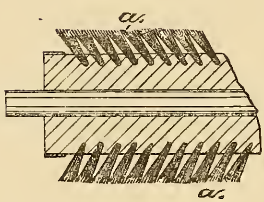
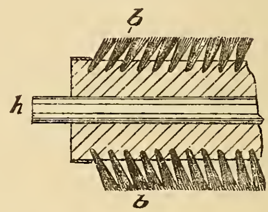


Fig. 195.



ing in contact with the leather *B* those of one row, as in Fig. 194, will yield and move toward the left end of the brush-cylinder, while those of the adjacent row (see Fig. 195), oppositely inclined, will move toward the right of the cylinder, the bristles of the two rows thus moving over the leather one after the other in opposite directions, in the direction of the length of the supporting roller a^4, at the same time that all the bristles sweep over the leather as it is carried under it by the roller a^4. In this way the blacking is brushed on the leather both longitudinally and transversely. The brush-cylinder has a metal journal at each end, the journal preferably forming part of a metal shaft extended through the cylinder *c* of wood. The cylinder *c* is provided with a series of diagonal holes at opposite inclinations (see Figs. 194 and 195), into which the bristles *a b* are inserted and held by glue and wooden plugs or galvanized nails, or in any usual manner.

Machine for "Smutting" Leather.

The machine shown in Figs. 196 and 197 is the invention of Mr. Charles B. Bryant, of the firm of Messrs. Bryant & King, the well-known calf-skin tanners and curriers near Woburn, Massachusetts.

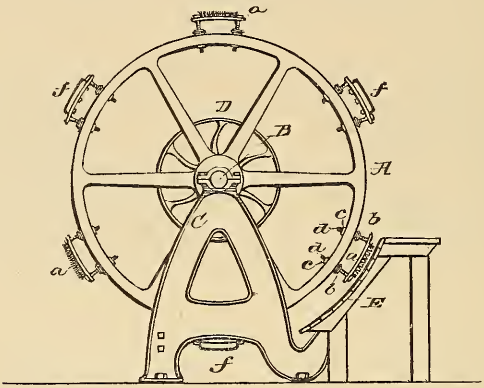
In the manufacture of upper leather, after the skin has been tanned, it is removed from the tanning-liquor and shaved, and subsequently, while wet, is scoured or washed to remove from it the dirt. Scouring brings the leather into condition to be oiled or stuffed, after which, the leather having been dried, it is whitened, and then grained and "boarded," as it is called, and thereafter blacked, and after blacking, the leather, to be fully finished, is "smutted."

This invention has for its object the production of a machine for "smutting" leather, smutting being one of the processes or steps for the fine or better finishing of leather. That class of leather, calf-skin, etc., wherein the black face produced by or due to the application of lamp-black and an oleaginous material, is most commonly used in the manufacture of boots and shoes and other articles of leather without smutting, and the face of the leather shows a dull black the material of which easily cracks off; but in some instances this black face is rubbed by a cloth and then by hand to rub the black into the leather and remove all surplus material therefrom, so that the black color will not rub off or smut when handling the leather. The process of smutting by hand—the only way it has been done up to the present time—is slow and expensive. In accordance with this invention, Bryant takes a hide or side of leather, blackened by machine or by hand, and subjects it to the action of rubbers or smutters and of brushes. The rubbers or smutters, by their friction against the leather, roll or rub up the black film or "skin," as it may be called, on the surface of the leather into small minute crumb-like particles, which are subsequently swept off or detached from the leather by the brushes.

Fig. 196 represents in side elevation an apparatus embodying Bryant's invention, and Fig. 197 a view of the same from the left of Fig. 196.

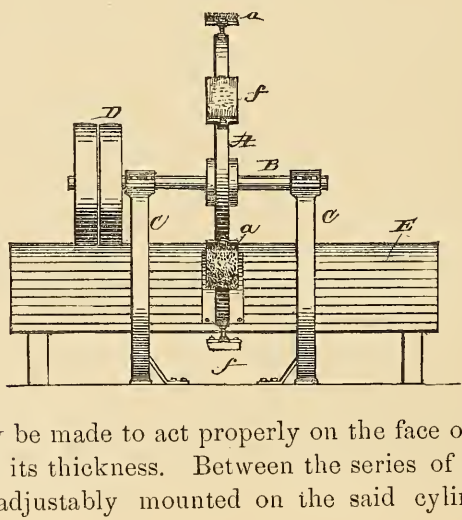
A represents a wheel or drum on a shaft, *B*, having its bearings in standards *C*, the shaft being driven by a belt on the fast pulley *D*.

Fig. 196.



The drum or cylinder *A* has attached to it a series of brushes, *a a*, the latter being shown as made adjustable with relation to the cylinder and the leather-supporting surface *E* by nuts *b c* on bolts *d*, as will be understood from the drawings, so that the

Fig. 197.



brushes may be made to act properly on the face of the leather, according to its thickness. Between the series of brushes, and preferably adjustably mounted on the said cylinder *A*, is a

series of rubbers or smutters, f, preferably composed of some sort of strong fabric. The inventor has used with good results pieces of Brussels carpet, and there might be employed for the rubbers or smutters either a fabric or a finer and softer brush than the brush a.

This machine operates, to perform the work required of it, at a very rapid rate as compared with handwork, and does its work even better than can be done by hand, improves the quality of the leather, and enables it to be sold for considerably more than the ordinary blacked leather which is not subsequently rubbed and finished as stated.

List of all Patents for Apparatuses for Blacking Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
107,625	Sept. 20, 1870.	H. P. Reed and Thos. E. Wilson,	Peabody, Mass.
128,658	July 2, 1872.	H. P. Reed and Thos. E. Wilson,	Peabody, Mass.
227,204	May 4, 1880.	F. B. Batchelder,	East Boston, Mass.
Reissue 9,794	July 12, 1881.		
227,836	Feb. 15, 1881.	F. A. Dupuy,	Ironton, Ohio.
251,401	Dec. 27, 1881.	F. B. Batchelder,	East Boston, Mass.
271,971	Feb. 6, 1883.	F. B. Batchelder,	East Boston, Mass.

Section II. Blacking Compounds.

The composition of the soap and oil blackings in common use by our American curriers has been described in the chapter treating the manufacture of upper leather, and the blackings which are now to be described are some of the patented compounds which are sometimes employed.

Flesh Blacking.

The following compound was patented by Hayward in 1846. To make one gallon of this blacking, dissolve one pound of pure potash in two quarts of soft water, then add to it one pound of tallow, and boil them together one hour; then dissolve one-quarter of a pound of potash in a quart of soft water, and stir

into it two-fifths of a pound of pure lampblack until it is well mixed, and add this decoction to the first one, and boil them together fifteen minutes. After which add one quart of "straits oil" and stir it well into the mixture and let it cool, and it is then ready for use.

Compound for Finishing Upper Leather.

In 1877 Shaw obtained a reissue of his patent for a composition for dressing leather, which is prepared as follows: First, one gallon of soft water, to which have been added six ounces of best extract of logwood, is heated nearly to the boiling point, but preferably not brought to boil, and is well stirred until the dye stuff is dissolved, after which it is allowed to cool. Second, one gallon of soft water, to which have been added six ounces of borax, is likewise heated nearly to the boiling-point, until the borax is dissolved. To this are added one and one-half pounds of gum-shellac, the same being gradually introduced in small quantities, and stirred briskly until thoroughly dissolved. Third, three-eighths of an ounce of bichromate of potash are dissolved in half a pint of hot water, in a separate vessel. This constitutes a proper mordant for converting the logwood extract into a black dye or soluble coloring matter, possessing a blue-black shade or tint.

Fourth, the first and second preparations are now added together by pouring the logwood solution into the solution of shellac, and stirring well until the two are intermixed. Then, while yet warm, the solution of bichromate of potash is added, and the whole briskly stirred for some time. This mixture is allowed to stand until entirely cool, and then, after skimming off whatever may have risen to the top of it, the liquor is drawn off for use.

To make a dressing which may be applied to leather in very thin coats, and at the same time produce a finer and brighter finish than could otherwise be obtained, mix with the liquor last described three or four ounces of concentrated water of ammonia or spirits of ammonia, and then put it up in cans tightly corked, ready to be applied to the leather.

The dressing may be made thicker or thinner, as required.

Finishing Split Leather.

The following composition is the invention of Joel Putnam, and is for finishing the inner side of split leather and giving it an appearance closely resembling the grain side of "kip leather." In carrying out this invention, first make a composition of one pound of glue, one-half pint of boiled linseed-oil, and about one-half ounce of vermilion, or other suitable pigment.

The glue should be dissolved in hot or boiling water, so as to make a solution of the consistency of such as is commonly used for cementing wood; afterwards the oil and the pigment should be thoroughly incorporated or mixed with the solution of glue.

The composition thus made is next to be applied to the surface of the piece of leather by means of a brush, two or any other suitable number of coatings being so laid on, and each being allowed to become dry before application of the next one.

After the application of each coating, it should be "glassed."

Finally, the leather so coated should be boarded.

List of all Patents for Blacking[1] *Compounds for Leather, issued by the Government of the United States of America, from* 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
2,431	Jan. 24, 1842.	N. A. Rowland and H. Miller,	Rowan Co., N. C.
2,660	May 30, 1842.	S. Adams,	Cleveland, O.
2,844	Nov. 4, 1842.	T. P. Merriam,	New Bedford, Mass.
3,144	June 24, 1843.	P. Hairll and D. Curran,	Roscoe, O.
3,401	Jan. 6, 1844.	W. J. Roome,	New York, N. Y.
4,498	May 9, 1846.	J. Hayward,	Cleveland, O.
23,065	Feb. 22, 1859.	L. R. Rockwood,	Worcester, Mass.
34,530 Reissue 7,509	Feb. 25, 1862. Feb. 13, 1877.	M. Shaw,	Abington, Mass.
39,986	Sept. 15, 1863.	A. Bond,	Philadelphia, Pa.
47,082	April 4, 1865.	R. Bartholow,	Cincinnati, O.
47,957	May 30, 1865.	P. W. Keating,	Norwich, Conn.
50,383	Oct. 10, 1865.	D. L. Pickard,	Rochester, N. Y.
50,780	Oct. 31, 1865.	A. Tomlinson,	Cincinnati, O.

[1] See also list of patents for coloring compounds.

No.	Date.	Inventor.	Residence
52,391	Feb. 6, 1866.	G. W. Corey,	Port Jervis, N. Y.
52,920	Feb. 27, 1866.	O. P. Whitman,	Lynn, Mass.
54,303	May 1, 1866.	J. A. Dean,	Easton, Mass.
54,616	May 8, 1866.	S. Sherwood,	New York, N. Y.
55,203	May 29, 1866.	T. James,	Medford, Mass.
56,526	July 24, 1866.	J. M. Butcher,	North Lewisburg, O.
57,567	Aug. 28, 1866.	N. F. Quimby,	Wilmington, Del.
58,532	Oct. 2, 1866.	W. K. Wykoff,	Ripon, Wis.
59,851	Nov. 20, 1866.	J. McCrellish,	Philadelphia, Pa.
65,535	June 11, 1867.	A. Boudron,	Philadelphia, Pa.
66,982	July 23, 1867.	C. McCleary, (executrix,)	Hollidaysburg, Pa.
70,737	Nov. 12, 1867.	W. B. Moor,	Winchester, Mo.
71,485	Nov. 26, 1867.	S. A. Hickel,	Spencer, W. Va.
73,730	Jan. 28, 1868.	H. Lake,	San Francisco, Cal.
76,897	April 21, 1868.	J. Engelhardt,	Carbondale, Pa.
78,372	May 26, 1868.	J. Herold and M. Brown,	Frederick, Md.
83,817	Nov. 10, 1868.	S. S. Allen,	Richmond, Md.
93,002	July 27, 1869.	J. Putnam,	Danvers, Mass.
94,897	Sept. 14, 1869.	J. Knapp,	Syracuse, N. Y.
97,857	Dec. 14, 1869.	L. Baumer,	Columbus, O.
98,916	Jan. 18, 1870.	W. B. Bruthingham,	La Fayette, Ind.
103,402	May 24, 1870.	G. F. Whitney,	Boston, Mass.
111,133	Jan. 24, 1871.	E. Milner,	Marquette, Mich.
114,354	May 2, 1871.	H. A. Sawyer and R. G. Sawyer,	Milwaukee, Wis.
118,842	Sept. 12, 1871.	C. Brumly,	Rochester, N. Y.
119,239	Sept. 26, 1871.	J. H. Patterson,	Glen's Falls, N. Y.
120,348	Oct. 24, 1871.	O. K. Tripp,	Rochester, N. Y.
124,760	Mar. 19, 1872.	H. A. Reams,	Durham, N. C.
128,873	July 9, 1872.	O. A. Goold,	Portland, Me.
131,245	Sept. 10, 1872.	J. Breinig,	Allentown, Pa.
133,400	Nov. 26, 1872.	J. N. Baratta,	Ayer, Mass.
135,310	July 28, 1873.	F. G. Bell,	New York, N. Y.
141,829	Aug. 12, 1873.	A. D. Strong,	Ashtabula, O.
144,801	Nov. 18, 1873.	J. L. Sneed,	Frankfort, Ky.
148,582	Mar. 17, 1874.	J. Townsend,	Darby, Pa.
155,206	Sept. 22, 1874.	C. E. Selss,	Brooklyn, N. Y.
155,860	Oct. 13, 1874.	J. Clausen,	New York, N. Y.
157,835	Dec. 15, 1874.	H. D. Jewett and J. D. Jewett,	St. Omer, Ind.
157,936	Dec. 22, 1874.	J. A. Sefton,	Cleveland, O.
158,907	Jan. 19, 1875.	E. Clark,	New York, N. Y.
160,741	Mar. 16, 1875.	C. Alvord,	Binghamton, N. Y.
161,203	Mar. 23, 1875.	J. Carmody,	New York, N. Y.
162,394	April 20, 1875.	A. K. Lee,	Galveston, Texas.

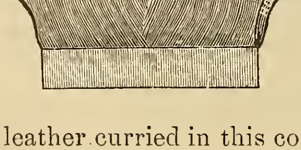
No.	Date.	Inventor.	Residence.
163,855	June 1, 1875.	J. I. Eastman,	Philadelphia, Pa.
168,220	Sept. 28, 1875.	J. H. Brown and J. G. Whiteside,	St. Louis, Mo.
176,105	April 11, 1876.	P. J. Weber,	Buffalo, N. Y.
178,319	June 6, 1876.	H. F. H. Miller,	Boston, Mass.
190,495	May 8, 1877.	C. L. Jones,	Stoughton, Mass.
203,138	April 30, 1878.	J. H. Gordon,	Brooks, Me.
203,498	May 7, 1878.	N. Quinland and J. H. Quinland, Jr.,	Glen's Falls, N. Y.
204,528	June 4, 1878.	C. H. Broad,	Rochester, N. Y.
209,570	Nov. 5, 1878.	J. H. Hyatt,	Newark, N. J.
241,876	May 24, 1881.	G. E. Millar,	Austin, Nev.
258,404	May 23. 1882.	J. H. Garrett,	Terre Haute, Ind.
259,009	June 6, 1882.	M. Hackett,	New York, N. Y.
259,188	June 6, 1882.	E. N. McKimm,	Lathrop, Mo.
260,416	July 4, 1882.	C. Richter,	St. Paul, Minn.
272,606	Feb. 20, 1883.	J. A. Van-Keuren,	Bridgeport, Conn.
277,017	May 8, 1883.	W. H. Durkee,	Cincinnati, O.

CHAPTER XXVI.

MACHINES FOR GLASSING OR POLISHING, PEBBLING, FINISHING, ROLLING LEATHER, ETC.

THE leather after being properly blacked is next glassed, and while this operation is sometimes performed by hand with a glass slicker, such as is shown in Fig. 198, still by far the

Fig. 198.



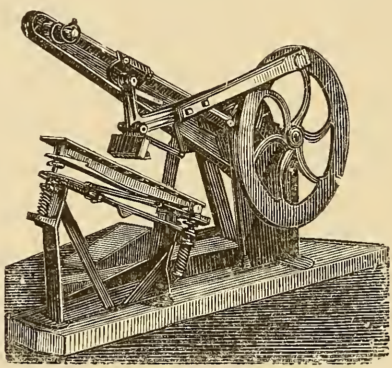
greater part of the leather curried in this country is glassed by machinery, and a large number of contrivances have been invented for this purpose as well as for pebbling, finishing, and

similar operations. The scarcity of labor in all the Northern States from the commencement of the late war of the rebellion, and the enormous demand for leather which immediately arose, stimulated inventors in all lines of leather production, and machinery for this purpose which came into use from 1860 to 1873 is still the kind that is now commonly employed in all sections of the country.

Martin's Machine.

Martin's machine, which is largely used by leather, Morocco, and lining finishers, was invented in 1860, and it is shown in perspective view in Fig. 199.

Fig. 199.



The machine is simple in design and very compact, the action is easy and silent, and the adjustment can be accomplished with facility. It can be operated at a high rate of speed, and its general employment by our leading finishers is an evidence of the quantity and quality of the work which it will perform.

In currying it will "set out," pebble, "stone out," "glass in black and paste," using either oil or soap blacking, entirely without hand labor.

In Morocco and lining finishing the machine will glaze, roll, pebble, and glass out, and perform the work in a satisfactory manner.

Martin's invention, shown in detail in Figs. 200 to 203, con-

sists in the employment, in combination with a yielding bed for sustaining the leather to be operated upon, of a reciprocatory carriage arranged about parallel with the bed, and a combination of pivoted levers, whereby the tool-stock is carried along in contact with the bed and back over it.

Fig. 200.

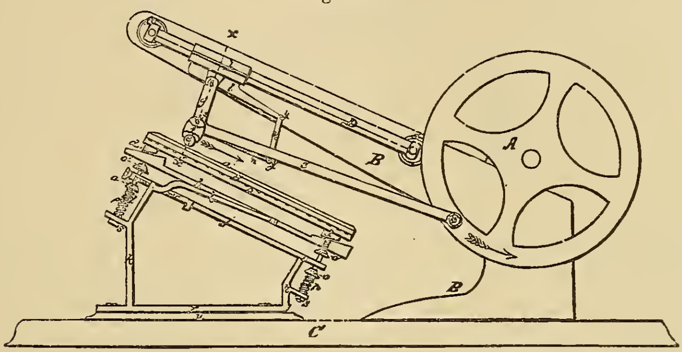
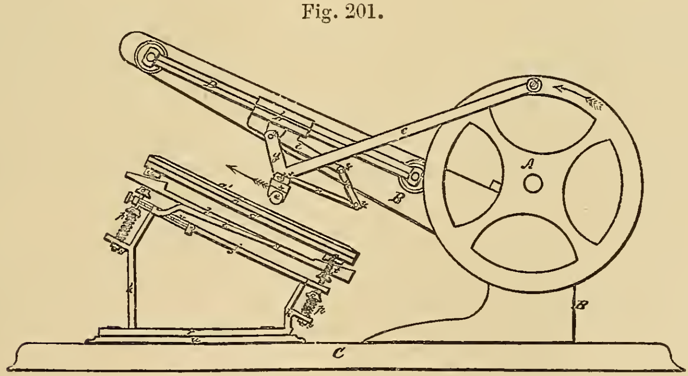


Figure 200 is a side elevation; Fig. 201 is a similar view, showing the parts in a different position; Fig. 202 is a detail section at the line x x of Fig. 200; and Fig. 203 is a detail sectional elevation of the work-table, which is omitted in Figs.

Fig. 201.



200 and 201 in order that the working parts of the machine may be more clearly delineated.

C represents the base or floor, on which are secured the working parts and the table and frame of the machine.

The frame B, the peculiar shape of which is clearly seen, may be made of any suitable material of proper strength, and to the side of the projecting arm portion of this frame is secured the square working bar or way D, upon which travels the

Fig. 202.

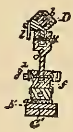
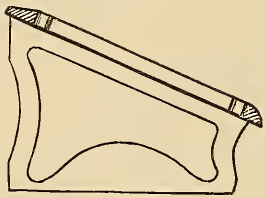


Fig. 203.



reciprocatory carriage b. This carriage b is driven through an intermediate combination of pivoted levers by a pitman, c, connected at v to the main crank-pin on the driving-wheel A, which latter may be rotated on its axis by any motive power. On the sill u is arranged the base-plate r of a metallic stand, j k k. At each end of this metallic stand is a screw-rod, on the lower end of which is a nut, s, and on which are arranged also two other nuts, o o', and a spiral spring, p. The lower one, o', of the two nuts o and o' is used to vary and control the action of the spring p on each bolt, while the upper nut, o, supports the adjusting-bar h. This bar has two inclined planes or oblique surfaces near its two ends, on which inclined surfaces rest the supporting blocks or lugs d d of the metallic bed c', on which the skin a' to be operated on is placed. This bed c' may be covered on top with a stratum of leather, as seen at b', Figs. 200 and 201.

On one side of the adjusting-bar h is pivoted, at x, one end of a rod, i, the other end of which has a nut in it, within which works the screw-rod v, which is provided with a knurled head, by means of which it is readily turned, for purposes to be explained.

f is the "hand" or tool-stock, in which is hung the tool e. To the carriage b is secured a plate, l, to which, at y y, are pivoted one end of pitman c, where it is bent up, as at g, and one end of a link, m, the other end of which the link m being pivoted in

turn to one end of bar n, which latter is pivoted at its other end to the angle of pitman $c\ g$, and also to the hand f by means of the pivot or stud y^2.

The operation of the machine thus far described may be thus explained: The leather to be rolled, pebbled, or otherwise operated upon being properly placed on the yielding bed at a', and the bed adjusted by means of the nuts $o\ o$ and sliding bar h, the motive power is applied to the main wheel A, causing it to rotate in the direction indicated by the arrow, and through the pitman c impart a reciprocatory motion to the carriage b.

At Fig. 200 the parts are shown as they are when the carriage b has just started on its downward stroke in the direction indicated by the arrow. It continues during this stroke to travel with the hand or tool-stock f in such position that the roll e travels in contact with and pressing against the upper surface of the leather or other stock being worked upon. At about the completion of this stroke, and while the crank-pin v is passing a dead-centre, the relative position of the hand f and carriage b is changed and the parts assume the position seen at Fig. 201, in which position the return or upward stroke of the carriage and pitman is made, the hand f, it will be understood, moving back above and at same distance from the leather. As the crank-pin v passes over the next dead-centre the hand f is again thrown down on to the leather, as seen at Fig. 200, and another stroke is made, and so on the rubbing over the surface of the leather of the hand is continued. As the operation of the machine continues the yielding bed is manipulated by the adjustment of the bar h, and supporting-nuts $o\ o$, and springs $p\ p$, and is familiar to those skilled in the use of the machine. It will be seen that while the machine is running the adjustment of the yielding bed up and down may be effected by turning the screw-shaft v. It will be seen that the various operations of rolling, pebbling, glazing, finishing, etc., may be performed on various kinds of stock by placing different tools in the tool-stock as is shown in the drawings; and it will be understood that by means of the jam nuts $o'\ o'$, in connection with the rods and springs p, the amount or degree of elasticity at each end of the yielding bed may be regulated and varied to suit the

peculiar nature of the different portions of the stock being operated upon.

Most of the features embraced in the yielding bed and its mechanism are so well known that we need not dwell upon that part of the description.

The feature that is not generally understood is in the method of applying and working the hand or tool stock *f*, by attaching it to a system of levers involving a sort of parallel motion in conjunction with a reciprocatory carriage driven from a crank-motion.

It is obvious that other peculiar combinations of pivoted levers and mechanical devices may be employed in connection with the carriage *b*, or its equivalent, to effect the same peculiar motion ascribed to the hand *f*, or to any tool which may be substituted for it.

Friend's Machine.

The glassing machine shown in Figs. 204 and 205 was invented in 1871 and further improved in 1875 by John P. Friend, and is adapted for work on all kinds of upper leather, sheep, goat, and Morocco.

The bed of this machine is level, and arranged upon the principle of the platform scales, in order that it can be so adjusted as to bring any point to bear either sidewise or lengthwise, and yet the turning of but one screw is required to increase or diminish the pressure uniformly. The pressure is equal at all points of the stroke, and may be increased sufficiently for pebbling without strain or injury to the machine.

This machine is all within itself, and simply requires placing in position and securing, when it is ready for the belting, and when it is in motion there is but little "jar" or "shock".

Fig. 204 shows a perspective view of Friend's machine.

The pendulous arm *A* is pivoted to the frame *B* by the links or connecting-bars *N* and *O*, which suspend and guide the vibrating arm, and by which its vertical and vibratory movement is limited. The lower end of the arm *A* is connected with the foot *C*, and carries, with the foot *C*, the tool-bar *D*, which is connected at the upper end with the pendulous arm by the link

E. A connecting-rod, *F*, is attached to the foot *C* and to a crank or crank-wheel, by which a vibratory movement is given to the machine.

Fig. 204.

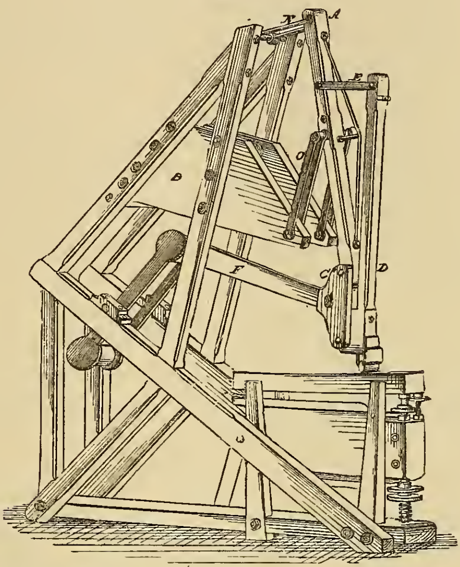
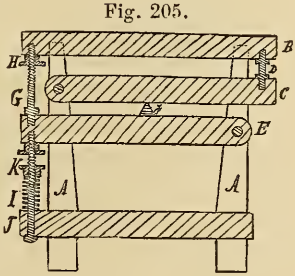


Fig. 205 shows a vertical section through the table of Friend's machine.

A represents the frame of the machine. *B* the bed-plate, upon which the leather to be finished is laid. The top of the frame *A* incloses and holds the bed-plate in position. *C* is the first lever below the bed-plate; it is jointed to it by the stud *D*. Below the lever *C* is another lever, *E*, and the fulcrum *F* is placed between the levers *C* and *E*. The bed-plate *B* and lever *E* are connected at the front of the machine by the bolt or connecting-rod *G*, and the distance between the lever *E* and bed-plate *B* is adjusted by the nut and screw *H*. The front end of the lever *E* is supported by the spring *I*, which works on the standard *J*, and the tension of the spring is con-

Fig. 205.



trolled by the nut *K*. It will be seen that, by this arrangement of levers, the adjustment of the bed is had entirely from the front of the machine. In all the machines used for glassing leather it had been the practice prior to this invention to employ one or more springs under each end of the bed, so that the tool when in the middle of the bed was resisted by the combined force of the two springs, while, when it was at either end of the stroke, it had the force of only one. This inequality of pressure is avoided by the use of the devices shown in Fig. 205, and the pressure is equalized through the whole of the stroke; and the vertical movement of the bed is parallel, and it does not rock at each reciprocation of the tool, as it does in the use of two or more springs.

Hildreth's Machine.

The machine for glassing, and which is also largely used for pebbling leather, invented in 1868 by Joseph W. Hildreth, is shown in Figs. 206 to 208.

Fig. 206.

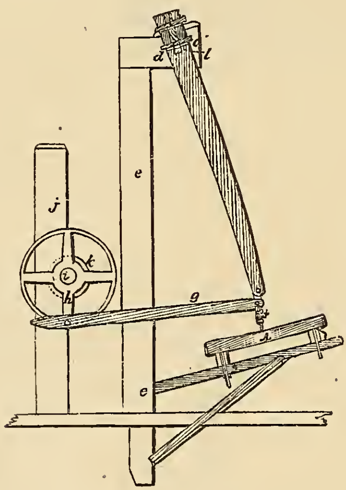


Fig. 207.

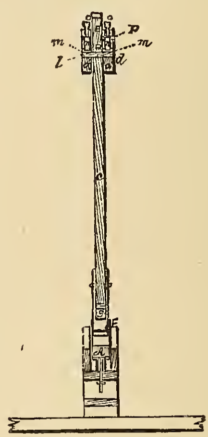
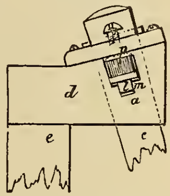


Fig. 206 shows a vertical, central, and longitudinal section of a common form of a "leather glassing" or polishing machine, and Fig. 207 a vertical and transverse section of such a machine with Hildreth's improvement applied thereto.

Fig. 208 is an enlarged side elevation of a portion of the machine, showing the elastic bearing to be hereafter described.

A denotes a metallic bed, concave upon its upper surface, resting upon and supported at each end by an elastic cushion or spring, the bed thus supported being upheld by a suitable framework applied to the floor of an apartment or building in which the machine is located.

Fig. 208.



A large number of the machines for glassing leather, prior to Hildreth's invention, were constructed so that as the polishing tool approached the centre of the bed *A*, the pressure upon the leather increased, and the leather became distended and baggy, and reduced in thickness in its central portion.

The object which Hildreth had in view in the invention of his machine was to obviate this defect by equalizing the distribution of the pressure upon the finishing-bed and leather.

Hildreth makes the point of suspension of the vibrating arm *c* an elastic one, in order to accomplish this.

The mode of applying the elastic bearing is as follows: The lever *c* is upheld by a horizontal cross-bar extending into guides or slots, *m*, *m*, made through the side bars *a′ a′* of the arm *d*, the lever *c* swinging between the two.

A spring, *n*, composed of India-rubber or other suitable material, is placed on top of each end of the cross-bar *l*, and within the slots *m*, *m*, as shown in Fig. 207.

A set-screw, *o*, is screwed through a cap-plate, *p*, applied to each bar *a′*, and over and closing the slots *m*, *m*, such set-screws pressing down upon a metallic plate placed over the top of each spring *n*, *n*, and serving to regulate pressure of such springs upon the cross-bar *l*.

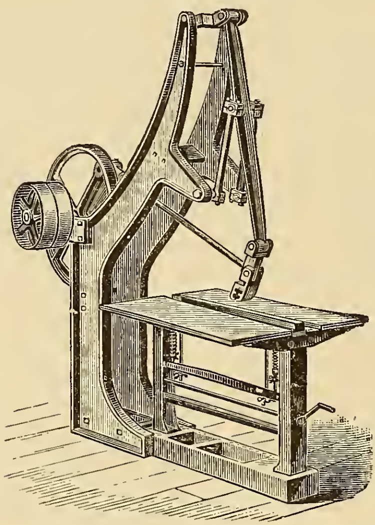
If considered necessary or desirable, metallic blocks, recessed for reception of the end of the springs *n*, *n*, may be interposed between the cross-bar *l*, and such springs to retain them in place, the blocks being formed with splicers or projections upon each, to slide in grooves made in the inner faces of the slots *m*, *m*.

Baker's Improved No. 4 Glazing Machine.

Baker's former machines for glazing leather have been in use by a number of the leading houses in the Morocco trade, both in this country and Europe, and have given universal satisfaction.

But the great advancement towards perfection in the Morocco business, requires an equal perfection in machinery for developing the art. Mr. Baker, having this in view, has added to his already successful machine some important improvements, which will at once command the attention of the progressive manufacturer. This new glazing machine, which is shown in Fig. 209, has been reduced in size to economize in space, yet

Fig. 209.



without lessening its capacity for doing the widest range of work. Another important point is, that the balance cranks have been substituted by a balance wheel and crank combined, thereby giving the advantage of the balance wheel, both of which, when placed inside the main frame, give it the required stability of the balance cranks with the advantage of the balance wheel having the power stored in it to overcome the dead cen-

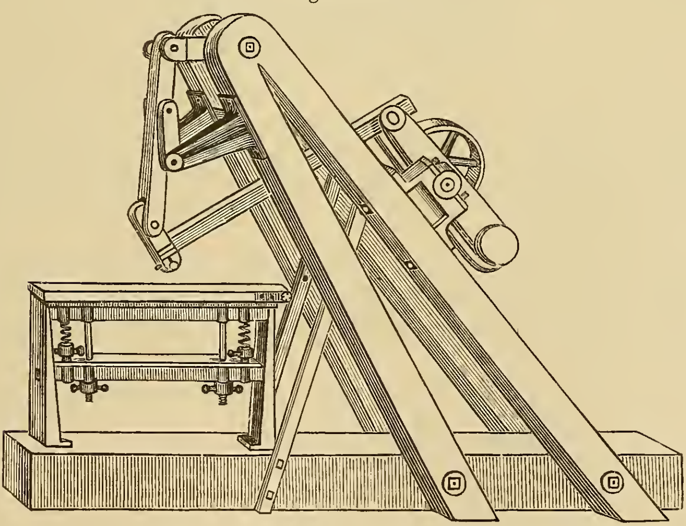
tres and return the beam with ease over the glazed surface of the leather. Another improvement claimed, is the new style clamp or holder, for holding the glass or agate; this clamp can be removed to put on any of the different rolling and pebbling attachments as readily as before. The horse or buck has been improved by the application of an arrangement for tilting the bed, in case the bed-strap should not be entirely parallel with the glass, which is performed by means of thumb-screws on the side, thereby saving time, and overcoming that imperfection in the stroke known to the trade as "cornering."

Baker's Pony Glazing Machine.

Baker's Pony Glazing Machine is shown in Fig. 210.

For a long time Morocco manufacturers have desired a machine that would perform all the work that the old-fashioned "buck" would do, and without its many disadvantages, and at

Fig. 210.



the same time at a cost that would not exceed that machine. To accomplish this end, Mr. G. W. Baker invented the pony glazing machine, as illustrated above.

It requires but a small space, and is so constructed as to do

any kind of glazing in a superior manner. The framework is made of wood; all the working parts are of iron, such as the crank shaft, pulley, and bearings, rock-arms, wrist-clamp, for holding the glass or agate, and are thoroughly substantial.

The horse or "buck" is entirely of iron, provided with springs and screws that move independently of each other, and in such a manner that the pressure on the skin can be regulated to a nicety. It uses the improved glazing strap, which stands highly with the trade for durability and the performance of good work.

Overhead Glazing Machines.

There is a class of the Morocco trade that uses an overhead glazing machine made of wood in several parts. One part, including the beam, is fastened to the joists above, with the iron horse immediately below it resting on the floor, and a short distance from the horse two upright posts are bolted to the joists with space between them for the iron balance-wheel. A wood connecting-rod connects the wheel with the beam, and all the working parts have metal bushings. It can be used very well in a good strong building, but where there are more than two, it makes too much strain on the floors, as they receive all the pressure, the force of the roller on the strap having a tendency to push the beam upwards, as it is fastened to the joists, and to push the horse downwards, thus causing the floors to be constantly vibrating.

There are quite a number of these machines in use, but parties will have more satisfaction from a portable machine; it requiring time and expense to change them, and when once removed being useless.

Those who have suitable buildings and wish this machine, however, will find it to do good work.

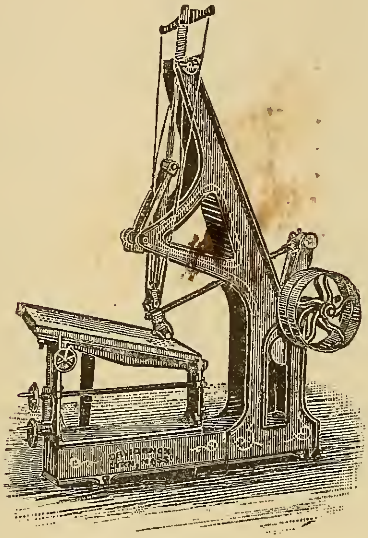
Knox's Machine.

The Morocco finishing and pebbling machine made by David Knox, is shown in Fig. 211. A medal and diploma were awarded to this machine at the Philadelphia Exposition of 1876; but since that time it has been improved and simplified.

The machine is easily adjusted, and requires but little power

to operate it, and Morocco and lining finishers hold it in high esteem. In a tour through the Morocco tanneries of the city of

Fig. 211.



Philadelphia, Pa., during the autumn of 1883, the author counted more than one hundred of these machines in operation in that city, which is a sufficient guarantee of the excellence of their work.

List of all Patents for Machines for Stoning, Polishing, Finishing, Glassing, Glazing, Flinting, Creasing, and Dicing Leather,[1] *issued by the Government of the United States of America, from* 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
3,957	Mar. 15, 1845.	R. Bracket,	Boston, Mass.
4,534	Aug. 29, 1871.	A. W. Pratt,	Salem, Mass.
7,433	June 18, 1850.	E. Brookout and H. Cochen, Jr.,	Williamsburgh, N. Y.
9,292	Sept. 28, 1852.	J. M. Poole,	Wilmington, Del.
10,379	Jan. 3, 1854.	P. T. Tapley,	Lynn, Mass.
12,806	May 1, 1855.	N. Ames,	Sangus, Mass.

[1] For other machines for glassing leather see list of patents for scouring machines on page 407, some of which are also used for glassing leather.

30

No.	Date.	Inventor.	Residence.
13,605 Reissue 839	Sept. 25, 1855. Oct. 18, 1859.	C. Weston, T. F. Weston, J. W. Weston,	Salem, Mass.
14,606	April 8, 1856.	W. P. Gamble,	Philadelphia, Pa.
14,821	May 6, 1856.	E. L. Norton,	Charlestown, Mass.
16,114	Nov. 25, 1856.	W. Crane,	Brooklyn, N. Y.
20,861	July 13, 1858.	J. R. Bumgarner, and L. W. White,	Davenport, Ia.
24,139	May 24, 1859.	T. Newhall,	Lynn, Mass.
24,344	June 7, 1859.	T. F. Weston,	Salem, Mass.
26,792	Jan. 10, 1860.	R. L. Smith and C. Smith,	Stockport, N. Y.
26,932	Jan. 24, 1860.	R. A. Stratton,	Philadelphia, Pa.
27,028	Feb. 7, 1860.	G. S. Adler,	Philadelphia, Pa.
27,300	Feb. 28, 1860.	W. P. Martin,	Salem, Mass.
27,885	April 17, 1860.	R. P. Boyce,	Erata, Miss.
28,108	May 1, 1860.	W. P. Martin,	Salem, Mass.
28,562	June 5, 1860.	S. P. Cobb,	South Danvers, Mass.
31,879	April 2, 1861.	W. Ellard,	Woburn, Mass.
40,735	Dec. 1, 1863.	S. P. Cobb,	South Danvers, Mass.
41,363	Jan. 25, 1864.	J. G. Bushfield,	Feltonville, Mass.
48,186	June 13, 1865.	R. Lee,	Newark, N. J.
52,728	Feb. 20, 1866.	W. P. Martin,	Salem, Mass.
66,125	June 25, 1867.	F. J. Burcham,	Racine, Wis.
76,914	April 21, 1868.	J. W. Hildreth,	Boston, Mass.
79,070	June 23, 1868.	J. F. Harris,	Swampscott, Mass.
80,829	Aug. 11, 1868.	P. Lenox,	Lynn, Mass.
85,030	Dec. 15, 1868.	C. Schmitz,	Philadelphia, Pa.
91,219	Jan. 15, 1869.	P. Farrell,	Albany, N. Y.
109,205	Nov. 15, 1870.	H. C. Havemyer and D. P. Burdon,	New York, N. Y.
114,809	May 16, 1871.	D. Harrington,	Boston, Mass.
115,312	May 30, 1871.	B. R. Hamilton and S. Swan,	Deerfield, Mass. Conway, Mass.
117,877	Aug. 8, 1871.	J. P. Friend,	Peabody, Mass.
118,146	Aug. 15, 1871.	G. H. Parker,	Detroit, Mich.
121,727	Dec. 12, 1871.	N. D. Morey,	Saratoga Springs, N. Y.
122,136	Dec. 26, 1871.	A. Shedlock,	Brooklyn, N. Y.
122,395	Jan. 2, 1872.	C. A. McDonald,	Woburn, Mass.
123,681	Feb. 13, 1872.	G. Crossley,	Philadelphia, Pa.
132,901	Nov. 12, 1872.	H. Cunningham,	Albany, N. Y.
139,442	May 27, 1873.	W. A. Watson,	Beverly, Mass.
150,849	May 12, 1874.	W. Ellard,	Woburn, Mass.
152,711	June 30, 1874.	W. Walter,	Yonkers, N. Y.
158,761	Jan. 12, 1875.	J. T. Tullis,	Glasgow, North Britain.
163,063	May 11, 1875.	J. P. Friend,	Peabody, Mass.
170,983	Dec. 14, 1875.	B. M. J. Blank,	Jersey City, N. J.

No.	Date.	Inventor.	Residence.
173,178	Feb. 8, 1876.	W. A. Perkins,	Salem, Mass.
207,930	Sept. 10, 1878.	A. J. Alexander,	Gallipolis, O.
208,918	Oct. 15, 1878.	C. Molinier,	Buzet, France.
229,895	July 13, 1880.	J. Liedtkie,	Brooklyn, N. Y.

List of all Patents for Machines used for Pebbling Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
14,821	May 6, 1856.	E. L. Norton,	
27,300	Feb. 28, 1860.	W. P. Martin,	Salem, Mass.
28,108	May 1, 1860.		
42,136	Mar. 29, 1864.	C. T. Woodman,	Boston, Mass.
48,876	July 18, 1863.	G. W. Pratt,	Salem, Mass.
60,115	Dec. 4, 1866.	J. C. Armes,	Northampton, Mass.
76,914	April 21, 1868.	J. W. Hildreth,	Boston, Mass.
117,877	Aug. 8, 1871.	J. P. Friend,	Peabody, Mass.
119,743	Oct. 10, 1871.	O. Coogan,	Pittsfield, Mass.
132,901	Nov. 12, 1872.	H. Cunningham,	Albany, N. Y.
135,350	Jan. 28, 1873.	N. O. Lounsberry,	Wilmington, Del.
140,633	July 8, 1873.	N. O. Lounsberry,	Wilmington, Del.
155,931	Oct. 13, 1874.	M. Dolan,	Boston, Mass.
157,632	Dec. 8, 1874.	P. O'Brien,	Boston, Mass.
159,092	Jan. 26, 1875.	A. M. L. Groff and J. A. Marvel,	Wilmington, Del.
161,046	Mar. 23, 1875.	N. O. Lounsberry,	Wilmington, Del.
161,269	Mar. 23, 1875.	A. W. Perrin,	New York, N. Y.
163,063	May 11, 1875.	J. P. Friend,	Peabody, Mass.
168,497	Oct. 5, 1875.	H. Howson,	Philadelphia, Pa.
176,535	April 25, 1876.	L. R. Jenkins,	Philadelphia, Pa.
205,974	July 16, 1878.	E. B. Parkhurst,	Woburn, Mass.
246,278	Aug. 30, 1881.	E. C. Allison,	Melrose, Mass.

List of all Patents for Machines for Rolling[1] *Leather, issued by the Government of the United States of America, from* 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	Oct. 19, 1812.	W. Edwards,	
	April 28, 1836.	McLaughlin and Hill,	Sunderland, Vt.
37,991	Mar. 24, 1863.	J. Whitney,	Winchester, Mass.
40,069	Sept. 22, 1863.	J. Whitney,	Winchester, Mass.
50,079	Sept. 19, 1865.	D. H. Priest,	Boston, Mass.
71,929	Dec. 10, 1867.	J. H. Walker,	Worcester, Mass.

[1] This list also includes machines for rolling sole leather.

No.	Date.	Inventor.	Residence.
93,465	Aug. 10, 1869.	C. W. Monson,	Upton, Ia.
98,889	Jan. 18, 1870.	J. F. Safford,	Winchester, Mass.
101,197	Mar. 22, 1870.	H. J. Weston,	Buffalo, N. Y.
101,234	Mar. 29, 1870.	G. Curtis,	Emporium, Vt.
115,443	May 30, 1871.	G. Curtis,	Emporium, Vt.
124,709	Mar. 19, 1872.	J. Whitney,	Winchester, Mass.
149,906	April 21, 1871.	J. Whitney and A. E. Whitney,	Winchester, Mass.
151,989	June 16, 1874.	S. R. Krom,	New York, N. Y.
171,574	Dec. 28, 1875.	N. Lindsey, J. McCullough, and W. Clement,	Lena, Ill.
171,867	Jan. 4, 1876.	Wm. H. Rosensteel,	Johnstown, Pa.
176,763	May 2, 1876.	J. C. Wells,	Warren, Pa.
194,352	Aug. 21, 1877.	H. Hudson,	Saltillo, Pa.
194,906	Sept. 4, 1877.	A. Hanver,	Union, N. Y.

CHAPTER XXVII.

Machines for Measuring Leather.

The heavy leathers are sold by weight; but light leathers, such as upper, Morocco, sheep-skin, and enamel leather, are sold by area. The yardstick, and the common measuring frame, having wires or cords running the length and across it, thus dividing the frame into square feet, do not require special description; but since 1877 there have been invented in the United States seven different leather-measuring machines, and taking Lynn, Mass., as the centre, all of them have been invented by persons living within a radius of about twenty-five miles of that place.

The leather-measuring machine invented by David T. Winter, of Peabody, is a convenient contrivance for measuring. The fault found with it by finishers of leather was that after purchasing the machine they were compelled to pay a royalty for its use to other parties who had gained a suit against Winter for an infringement of their patent rights. But Mr. Winter has lately

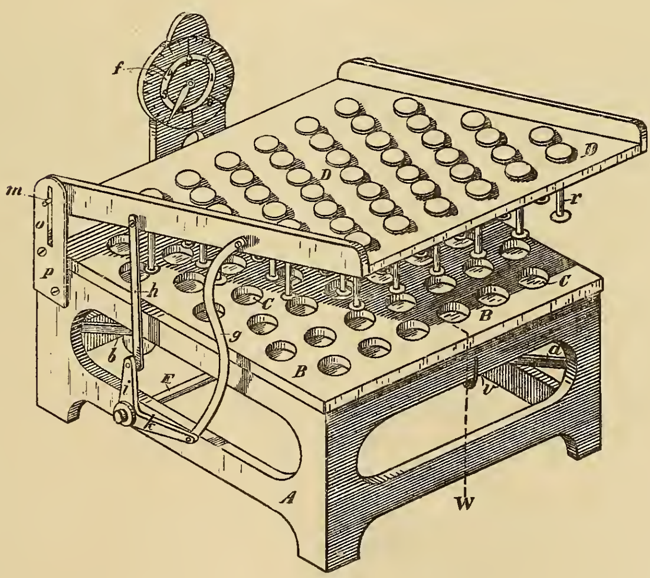
secured the control of a leather-measuring machine which is thought to be free from the objections to the one just mentioned.

Williams, Moore, and Hulburt's Leather-Measuring Machine.

The leather-measuring machine shown in Figs. 212 to 216 was invented by Williams, Moore, and Hulburt, in 1879.

The operation of the machine is as follows: The table D being raised, as shown in Fig. 212, the skin or article to be measured is spread upon the table B, and the table D, carrying the pins $r\,r$, is brought down upon it, assuming a horizontal position before reaching it, and the pins are deposited in a perpendicular position upon the weighing-platform C, except such as are intercepted by the skin. (See x, Fig. 213.)

Fig. 212.



The dial f being so marked that when all the pins rest upon the weighing platform the pointer will indicate 0, and the pins upon each square foot of surface that are removed from the weighing platform allowing the pointer to recede a space

marked one foot, the area in square feet is indicated correctly, except as far as the brake S may prevent it. A slight pressure then applied to the end of the rod v, forcing it back, removes the pressure of the brake S and allows the pointer on the dial f to indicate exactly the correct measurement.

Fig. 213.

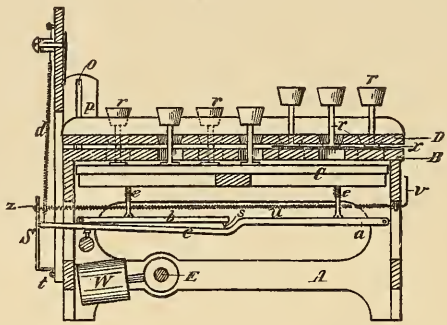
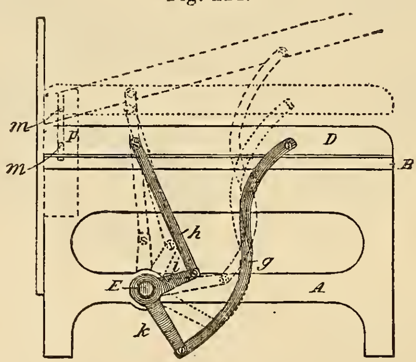


Fig. 212 is a perspective view; Fig. 213, a vertical cross-section at line w, Fig. 212; Fig. 214, a diagram showing the position of the table carrying the pins and its supporting-levers at different elevations; Fig. 215, an interior end elevation; and Fig. 216, a modified form of pin.

Fig. 214.



The following is a description of the manner in which this machine may be constructed: The table D is four and one-half feet wide, the shaft E may be nineteen and one-half inches

below the same, and fifteen inches from the rear side of the frame *A*. The arms *i* and *k* and the bars *h* and *g* should be of the following lengths, measuring from the centres of their

Fig. 215.

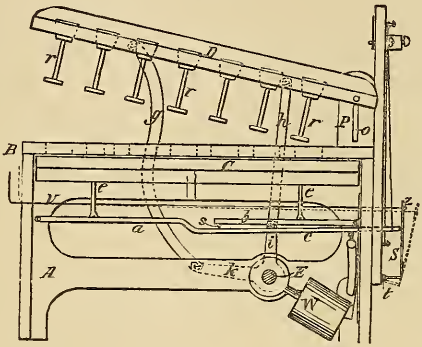
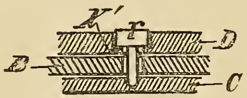


Fig. 216.



pivotal points in each case: arm *i*, nine inches; arm *k*, twelve inches; bar *h*, twenty-two and one-half inches; bar *g*, thirty-eight inches. The upper end of bar *h* should be pivoted to the table *D* thirteen and one-half inches from its rear side, and bar *g* twenty-five inches from bar *h*, and fifteen and one-half inches from the front side of table. The arms *i* and *k* are at such an angle to each other that the distance from the extreme pivotal point of one to the same point in the other is thirteen and one-half inches. These dimensions may be varied to suit the conditions required.

Upon the shaft *E* is a hub with a radial arm carrying a weight, *W*, so that as the shaft is turned in either direction the weight is moved in the arc of a circle of which the shaft *E* is the centre. If the arm carrying the weight *W* be adjusted (by a set-screw in its hub) in a perpendicular position over the shaft *E* when the table *D* is at its lowest point, it will be readily seen that in this position the weight *W* exerts no upward pressure

on the table D. If, now, the table be raised from its lowest to its highest point, the weight M will, by the turning of the shaft E, be moved from its position over it to one at its rear, and thus exert a gradually increasing pressure against the table D. It is preferable to set the arm carrying the weight at a slight angle backward from a perpendicular position over the shaft E when the table D is at its lowest point; but any adjustment may be made that will suit the convenience of the operator, it being understood that as the table D, carrying the pins or weights, approaches and the pins are supported by the weighing platform, it is necessary, for ease of operation, that the table D should be at least partially relieved from the upward pressure of the weight W.

The pins, which are represented in Fig. 212 as suspended in the table D, and are shown in section in Fig. 213, are formed with a slender shank or body and a base of sufficient size and weight to enable them to stand upright without side support when deposited in a perpendicular position upon a level surface. The heads by which they are suspended are the frustums of cones having their larger diameters uppermost, and are of sufficient length to hold the pins firmly in a perpendicular position when placed in holes in which they fit closely.

The holes in the table B are so arranged that when the table D is brought down upon it they coincide with those in D, and are of such a size that the bases of the pins will readily pass through them. These pins are of such a length that when their bases rest upon the weighing-platform C, and the table D has been brought close down upon B, their heads will project for at least their entire length above the table D, and thus be free from contact therewith. This construction allows the pins to stand on the weighing-platform entirely free from support by the table D, and admits of an accurate weighing of the pins, which is impossible in machines as heretofore made.

Fig. 216 represents another form of pin, which accomplishes the same purpose in a slightly different way. The head of this pin is cylindrical, and is prevented from slipping through the table in which it is supported by a slight contraction of the hole just at its lower surface, as shown at X, and it has no enlarged

base, but is slightly rounded or pointed, so it may readily enter a hole or socket in the weighing-platform, by which it is supported in an upright position.

In practice the tapered heads, as shown in the main drawings, are often preferable; but the pointed pin may be used with advantage in certain cases.

It has been found that the oscillation of the pointer of the dial *f*, connected with the weighing mechanism, is an obstacle to rapid work. This is overcome by means of a brake or lever, *S*, pivoted to the frame *A* at *t*, and held lightly against the end of lever *c* by a spring, *u*, one end of which is attached to the front part of the frame *A* and the other to the brake *s* or the rod *v*, which is attached to it at *z*, and which extends across to the front of the machine, as shown. The spring may, for convenience, encircle the rod, as shown.

By pressing the projecting end of the rod *v* backward the brake may be removed from contact with the lever *c*. This may be arranged so as to operate automatically by the descent of the table *D*; but it is preferable to operate it with the knee of the operator.

Sawyer's Leather-Measuring Machine.

The Sawyer self-adjusting leather-measuring machine is shown in Figs. 217 to 224, and it is constructed on a different principle from other machines for measuring the areas of surfaces, and it can be operated either by hand or power.

A minimum of power will run this machine, and it can be operated at a fast or slow rate of speed; 40 revolutions per minute is a good average, which gives five sides in that time. Wax, grain, enamel, goat and sheep-skins are perfectly measured by this machine, which is made in different sizes to suit the various leathers. The machine is made of metal, and any of the series of wheels may be removed or replaced without interfering with the others.

In machines of this class as first constructed the cords from all the winding devices were connected to one and the same cord, which actuated the index-finger of the scale. This arrangement was found objectionable on account of the friction

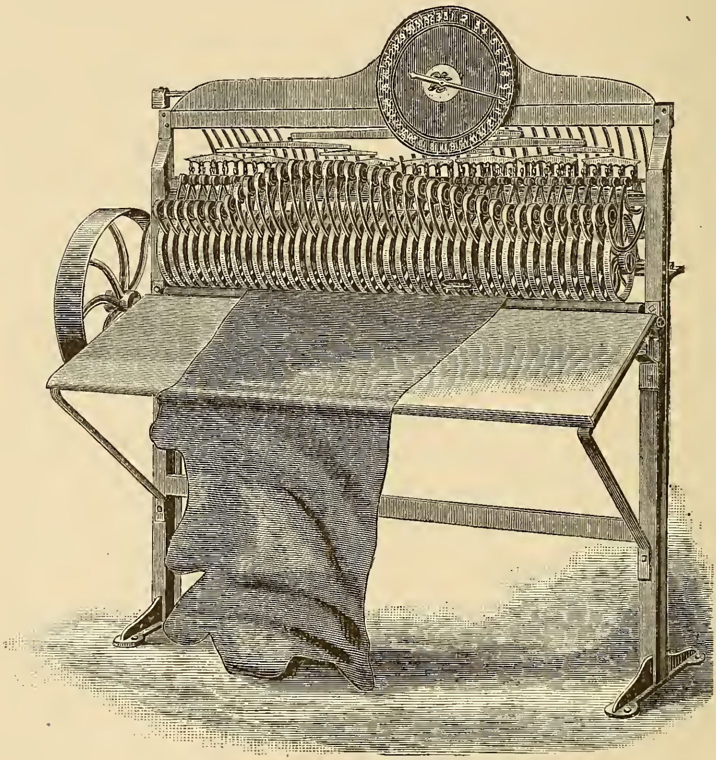
caused by the great number of pulleys required and the difficulty with which the long cord rendered through them.

One object of this invention is to obviate these objectionable features; and Sawyer's invention consists in an arrangement of levers by which the travel of each measuring-wheel is caused to properly affect the index of the registering device.

The article to be measured is fed into the machine between the wheels and roller, and the leather is smoothed out as it passes between them and so records every inch in the surface.

Fig. 217 illustrates a perspective view of the front of the Sawyer Machine. Fig. 218 a partial rear elevation of the

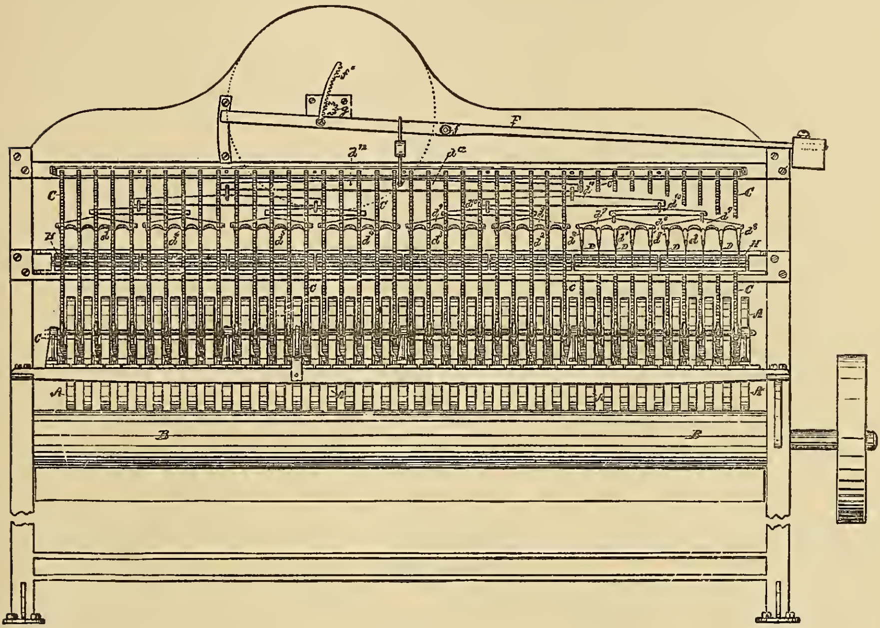
Fig. 217.



machine with the latest improvements embodied. Fig. 219 is a view, on a larger scale, of one set of five cords and their por-

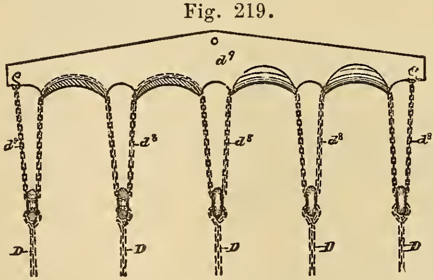
tions of the main cord, showing the connection with the system of levers. Fig. 220 is a partial cross-section, showing a novel

Fig. 218.



way of supporting the toothed segments, so as to allow the removal of any one of the wheels without disturbing the others.

Fig. 219.

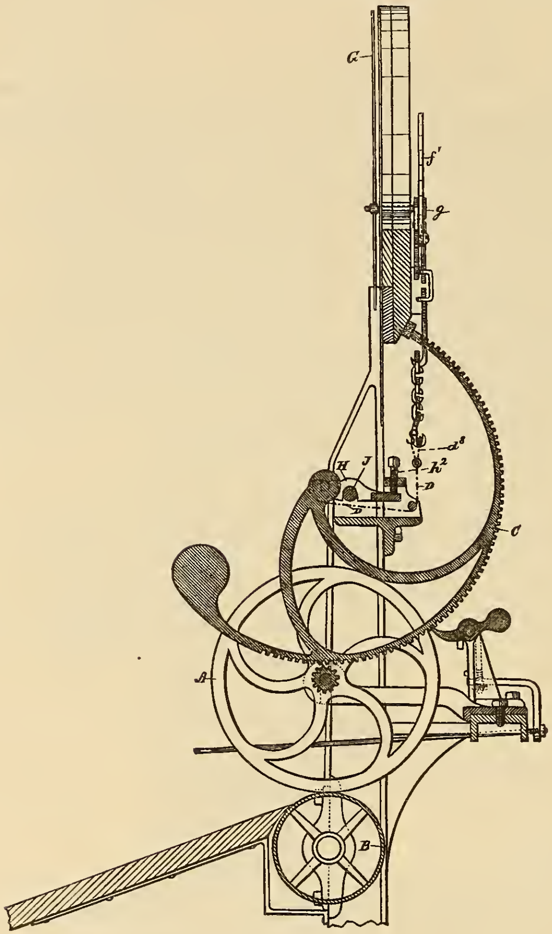


Figs. 221 and 222 are details of the toothed-segments support. Figs. 223 and 224 are modifications of the system of levers.

The width of the machine depends upon the number of wheels,

and varies for different varieties of leather, as has been stated. In Fig. 218 is illustrated one of the largest size for measuring enamel leather, made from whole hides, and is provided with

Fig. 220.



forty wheels. In all, however, each wheel is a separate measuring-machine, so that each machine will measure widths varying from that of one wheel up to the total number of wheels. All the wheels *A* rest on a roller, *B*, which is revolved

by any of the well-known means. Each wheel has a hub projecting slightly beyond its rim and side. Each projecting part of the hubs is toothed, and is placed immediately below a toothed-segment (marked C in Fig. 220). To each of the hubs

Fig. 221.

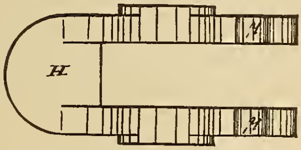
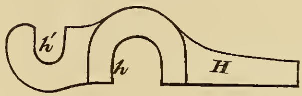


Fig. 222.



of these segments is attached a cord, D. When an article—such as a side of leather—is inserted between the wheels A and the roller B, a greater or less number of the wheels, according to the width of the article, will be raised, and their toothed hubs

Fig. 223.

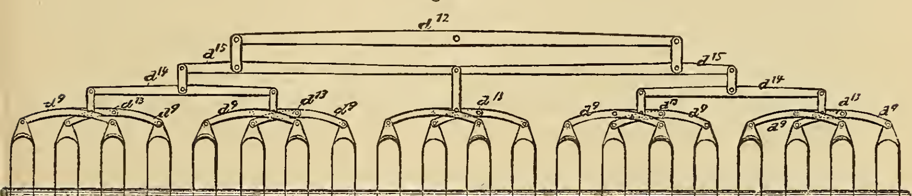
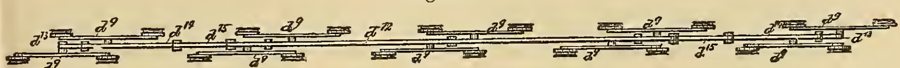


Fig. 224.



be caused to engage with the teeth of the segments C. As the article is drawn in by the revolution of the roller B, the wheels in contact therewith will rotate and cause the segments with which their hubs mesh to rotate and wind up the cord attached to their hubs, and the total length of cord so wound up will indicate the total area of the article that passed under the wheels. To aggregate the measurements of the cords by means of a series of levers, the cords may be divided into sets, as indicated by the letters d, d', d^2, d^3, d^4, d^5, d^6, and d^7 in Fig. 218. Each cord is secured at each end, d^8, to a small lever, d^9, but renders freely through rings or pulleys. Two of these small levers d^9 are

pivoted at their centre to the opposite ends of a lever, d^{10}, which may be pivoted at its centre direct to a weighted arm, F, pivoted to the frame at f, and carrying a racked segment, f', which, meshing with the pinion g, causes it to revolve when the arm F is moved. The index-finger G is fast to the shaft of the pinion g, and consequently moves with it. This arrangement would constitute a complete machine of ten wheels. For a complete machine of twenty wheels, two levers, d^{10}, each having two small levers, d^9, with their two sets of five cords, would be pivoted to the arms of a lever, d^{11}, which would be pivoted at its centre to the weighted arm F. For the machine of forty wheels (illustrated in Fig 218), two of the twenty-wheel connections above described are pivoted to the ends of a lever, d^{12}, which is pivoted at its centre to the weighted arm F. By thus shortening the cords the inventor is enabled to substitute for them small chains, which not only render freely and work perfectly, but are also much preferable on account of not being affected by moisture and of their greater durability. The toothed segments, cords, and levers being arranged as has been described, the same amount of displacement of any one or other member of the segments will cause the index-finger to move the same distance over the graduated scale. The movement of the index-finger is always exactly proportional to the number of segments displaced and the aggregate amount of their displacements—that is to say, in measuring a surface of one hundred and forty-four square inches area, it would make no difference whether it were a strip, one and a half inches wide and ninety-six inches long, and rotated only one wheel during its passage, or whether it were a piece nine inches wide and sixteen inches long and rotated six wheels during its passage, or whether it were of varying widths in its length and rotated a different number of wheels according to its varying widths. The index-finger would in each case indicate the correct area.

It will be obvious that the arrangement of levers may be varied, the requirement being that the arrangement shall be such as to correctly aggregate the motion of every measuring-wheel. Thus in Figs. 223 and 224 the wheels are shown in pairs, one cord from each pair extending round a pulley, and two of these

pulleys on each small lever d^9. These small levers are connected in pairs by the levers d^{13}, and each pair of levers d^{13} is connected by a lever, d^{14}, each lever d^9, in this case, being connected with four wheels—two at each end—each lever d^{13} with eight wheels, and each lever d^{14} with sixteen wheels, as shown in Fig. 223. Now, were there but thirty-two wheels in the machine, two levers d^{14} would be connected—one at each end—with lever d^{12}; but if forty wheels be used, then each lever d^{14} should be connected to a lever, d^{15}, and these two levers d^{15} should be each connected with a lever d^{13} connected with eight wheels to make up the forty, and as the levers d^{15} have sixteen wheels at their outer ends and but eight wheels at their inner ends, or four for each lever d^{15}, the levers d^{15} should each have an arm four times as long as the other arm.

Figs. 220, 221, and 222 illustrate the new way of supporting the toothed segments C, so as to allow any one of them to be removed when required to take out or replace any one of the wheels without disturbing the others. The support H is provided with two half boxes, h h', one of which, h, serves to receive the cross-rod J, on which all of the supports H rest. The half box h' receives the journals of the toothed segment C, which is carried by the support H. It will be evident that with the parts so arranged any one of the segments and its support can be lifted out at pleasure and afford access to the wheel below. This arrangement is of much practical value, since in the machines as heretofore constructed the rod J passed through the supports H, and the toothed segments were mounted on pins passing through them and secured in jaws formed on the ends of the supports, so that the whole had to be taken apart to replace a wheel. The supports are adjusted by means of set screws h^2, so as to regulate the space between the toothed hubs of the wheels and the segments.

List of all Patents for Machines for Measuring the Areas of Hides, Skins, and Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
194,662	Aug. 28, 1877.	M. V. B. Ethridge,	Lynn, Mass.
194,743	Aug. 28, 1877.	F. F. Tapley,	Lynn, Mass.
Reissue 9,204	May 18, 1880.	C. H. Porter,	East Stoughton, Mass.
208,942	Oct. 15, 1878.	D. T. Winter,	Peabody, Mass.
215,853	May 27, 1879.	D. T. Winter,	Peabody, Mass.
218,802	Aug. 19, 1879.	J. H. Williams,	Newton, Mass.
		S. Moore,	Newton, Mass.
		R. H. Hulburt,	Sudbury, Mass.
228,791	June 15, 1880.	J. S. Wentworth,	Lynn, Mass.
231,741	Aug. 31, 1880.	D. T. Winter,	Peabody, Mass.
256,058	April 4, 1882.	W. A. Sawyer,	Danversport, Mass.
258,969, 258,970	June 6, 1882.	D. T. Winter,	Peabody, Mass.
269,962	Jan. 2, 1883.	W. A. Sawyer,	Danversport, Mass.
281,745	July 24, 1883.	C. G. Winter,	Boston, Mass.
286,078	Oct. 2, 1883.	W. A. Sawyer,	Danversport, Mass.

PART VII.

CHAPTER XXVIII.

SOLE LEATHER.

Section I. General Remarks.

By sole leather in the broadest sense we understand a thick leather prepared by tanning heavy hides of oxen, heifers, and cows with any substance, either vegetable or mineral, that will change the nature of the hide so as to render it suitable for boots and shoes.

In this country the materials generally employed for converting hides into leather, are oak and hemlock barks; when the two are used together, the leather is called "union tannage."

In the manufacture of sole leather it is sought to combine the greatest possible amount of tannic acid with the hide, and this branch of the tanner's art requires the highest knowledge of the business. While in the production of upper leather as much depends upon the currying and finishing as upon the tanning, and in that variety of leather it is not sought to place the greatest possible amount of tannin in the hide.

Oak-tanned sole leather commands the highest price in the market, which arises from a variety of causes. The coloring matter and resin imparted to the hemlock-tanned leather have a tendency to make it harder and more brittle, which militates against it in the market. On account of the better price obtained for oak-tanned leather, the producers of this variety are enabled to pay a better price for the choice of hides, thereby securing usually the best, and the extra price also allows greater care to be exercised in the tanning and finishing of the stock.

As far as the astringent principle of hemlock and oak bark is

concerned there is no difference between them in their action on the hide, which cannot be truthfully said of the japonica and other highly concentrated tanning agents so enormously used in Great Britain. In commerce the hemlock-tanned leather is again graded into two classes, the better being styled as "hemlock non-acid," and the lower grade as "hemlock acid;" but this is not, accurately speaking, a truthful descriptive division of the two processes commonly employed for accomplishing the "plumping" or distending of the hide for the reception of the tan liquor, as an acid is really used in both cases, the difference being that a vegetable substance (mostly gallic acid) is employed in the first place, and sulphuric, a mineral acid, in the second.

In this country sole leather is divided into the following varieties:—

Hemlock.

Buenos Ayres, light, non-acid; middle weight; overweight.
California, light; middle weight; overweight.
Common hide, light; middle weight; overweight.
Acid, all kinds, light; middle; heavy.
Good damaged, all kinds and weights.
Poor damaged, all kinds and weights.
Prime export and jobbing leather, heavy.
Calcutta buffalo, light; middle; heavy; damaged.

Oak Slaughter.

Dressed backs, light; middle; heavy.
Belting buts, rough.
Bellies.
Light Philadelphia and Baltimore tanned.
Middle.
Heavy.
Louisville, no brands, X.
" A.
Country tanned, light; medium; heavy.

Oak Texas Hide.

Good to best, middle and heavy weights.
Common to good.
Good damaged, best tannages.

Union Slaughter.

Light backs.
Middle backs.
Heavy backs.
Damaged backs.
Light crop.
Middle crop.
Heavy crop.
Bellies.
Heads.

The sole leather which will be described in the next section is that known as "oak slaughter," and the process which we shall give, is that employed at the large and well-known tannery located at Luray, Va. The tan-bark employed is known as chestnut-oak, and the hides are derived from Chicago, Ill., St. Louis, Mo., Memphis, Tenn., Baltimore, Md., and Washington, D. C.

Section II. Tanning and Finishing Oak Slaughter Sole Leather.

The hides are placed in the "soaks," in which vats of water they remain three or four days, the period depending upon their condition, the water being changed with each pack of hides.

From the "soaks" the hides are carried to the lime vats and are changed each day by means of a reel into stronger lime, and in these vats the hides remain until the hair is loosened. They are next unhaired, and afterwards fleshed, and then thrown into a vat of clear water and left to remain over night.

In the morning the hides are removed from the clear water and "grained," which process consists in scraping the hides on the grain side in order to cleanse them more thoroughly from the lime remaining in the pores.

After being "grained" the hides are again placed in clear water, where they remain for three or four hours, which completes the beam-house work.

The hides are next suspended in the "handlers," which operation is the first stage of the tanning process. They remain in the handlers for about three weeks, the liquor being at first quite weak, but is changed each day upon the hides, being gradually made stronger.

After being properly "plumped" the hides are removed from the handlers, and are placed upon a truck, and conveyed upon a tramway to the "lay-away yard," where the tanning process is completed.

The "lay-away vats" measure nine feet in length, seven feet in width, and six feet deep, and in these vats the hides are placed one by one, spread out flat, and a thin layer of dry,

ground bark is sprinkled over each hide, in order that the liquor may circulate uniformly. About eighty-five hides form a pack for each lay-away vat.

After the hides have laid-away for a sufficient length of time to extract the tannin partially out of the "liquor," they are taken out and the liquor run off into a receiver through wooden pipes and pumped by steam power back to the leaches, where it passes through the bark and is restrengthened and then run as new liquor into the tan vats, and the hides are then put back as before.

Each "pack" is usually "laid-away," *i. e.*, given new liquor five times, the whole operation of tanning extending over a period of about five months.

From the "lay-away yard" the hides are placed on trucks and conveyed on a tramway to the scouring machine.

The scouring machine used for this variety of leather is shown in Fig. 141; before the hides are scoured they are split into sides. Each scouring machine will turn out one hundred and twenty-five sides of scoured leather per day. From the scouring machines the sides go into the drying loft, which is situated over the tanyard, and of course in a connecting building with that in which they are scoured. The loft is heated by steam which circulates through a series of pipes connected with the boiler.

In the loft the sides are suspended on sticks two by two inches and eight feet long, which sticks are partially rounded upon the edge that comes in contact with the side of leather.

Two sides are suspended upon each stick about one foot apart, and a passage-way 6' 6″ wide is maintained in the centre of the loft, and on each side of this passage-way two rows of sticks for holding the hides are placed.

The steam pipes used for heating the loft are placed about 2′ 6″ away from the outside rows of leather, and are attached to the upright studding and pass around the loft.

In drying sole leather it is very desirable that too much light should not be allowed to enter the loft, as it is injurious to the color.

Around the base of the drying loft the weather-boarding is

hung on hinges which can be adjusted to admit air without too much light; the windows in the loft admitting only sufficient light for the workmen.

In the peak of the building are other openings so constructed as to be easily opened, and closed, thus creating a constant draft. The steam pipes are self-acting, and distribute heat more gently and uniformly than the old manner of drying with stoves. Experience has shown that the sides are the proper places to fasten the steam pipe, and the current of air from the outside is usually sufficiently strong to force the heated or dry air to the centre, and thus form a current towards the top openings. Without such openings the air forms a current up the sides of the building and does not reach the centre. The effect of side openings, other than the kind mentioned, is to create counter currents, thereby destroying the whole effect. With pipes for a circulation of steam properly arranged in connection with an intelligently constructed drying-loft, sole leather wet from the vats can be dried in forty-eight hours, ready for the roller.

The sides of leather are not allowed to become entirely dry, sufficient dampness being allowed to remain in them for rolling, which operation is conducted in a building on a level with the drying-loft and opening into it, but in which a larger amount of light is admitted for the workmen than could be allowed in the drying-loft.

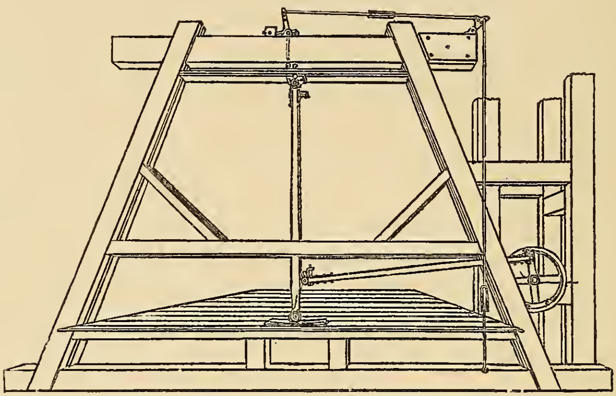
The rolling machine shown in Fig. 225 is the kind generally employed for rolling sole leather. These machines are manufactured by the Eureka Bark Mill Co. of Lancaster, Penn. The rollers on these machines are made of brass, and are six inches in diameter and six inches face or length, and are turned to a true surface and work into roller beds or concaves, which are also of brass and planed true to the radius or length of the vibrator or pendulum of each machine.

The pressure of the rollers upon the leather is imparted by means of levers connected with the vibrator or pendulum of each machine, and controlled by a lever worked by the foot of the operator; the hook to which the foot-piece is connected is shown in the drawing of the machine.

A list of patents for rolling machines, including those used for sole leather, is given on page 467.

After the roller has passed over a portion of the side two or three times it is shifted by the hands of the operator until all parts are successively operated upon.

Fig. 225.



The side is then placed in the loft, and on the following day it is again rolled and hung in the loft, and when dried the sides of leather are ready for market.

From the time that the green hides arrive at the tannery until the finished sides are ready for use, the time consumed is about six months, two processes of tanning being completed each year.

Section III. Tanning Inside Sole Leather.

The term inside sole leather, though very old, is by no means correct, since this variety of leather is chiefly used for soles of ladies' shoes, only the offal (head and sides), with exception of hides much punctured by the larvæ of gadflies, which are not fit for any other purpose, being employed for the manufacture of inside soles.

The mode of tanning this variety of leather is nearly the same as that of ordinary sole leather, the principal difference being,

that the hides are seldom sweated, the hair being loosened by liming.

Dry hides are sometimes used, although thin domestic hides of cows and oxen, but weighing heavy, are generally employed for manufacturing inside sole leather. When green hides are employed they are soaked for twelve to twenty-four hours, rinsed and freed from dung during this time, and placed, after final rinsing and draining off, in weak milk of lime. Dry hides must be thoroughly soaked before placing them in the "limes."

The hair of green hides, frequently handled, will become loose in from six to eight days, while about fourteen are required for dried hides.

As soon as the hair can be easily pulled out depilating is proceeded with.

After being unhaired the hides are soaked for twenty-four to forty-eight hours with frequent rinsing, and then fleshed, which is done in the same manner as with sweated hides. After fleshing they are placed in a vat of water, fresh water being admitted every day and the hides handled twice daily.

After six to eight days, according to the higher or lower temperature, scouring is proceeded with. In case the hides feel rough upon the grain side they are smoothed by forcibly driving the "stock stone" over the grain side, this being of advantage even if the hides feel entirely smooth.

The hides possess a sufficient degree of softness when the ground and lime-slime is easily removed, and the impressions made by passing the fingers over them remain visible for some time. They are then placed in water for a few hours or over night, and finally brought into the "handlers."

Inside sole leather can be raised in the liquors from which sole leather has been removed.

The treatment of the hides in the handlers and the after-processes are the same as those described for hides intended for sole leather.

Section IV. Bleaching Hemlock Tanned and Union Tanned Leather similar to Oak Tannage.

This invention, which is that of E. W. Phillips, of Waverly, N. Y., consists in bleaching hemlock-tanned and union-tanned leather similar to oak, and also has for its object to increase the percentage of leather from a given quantity of hides.

To carry out this method proceed as follows: For fifty hides or one hundred hides, of average weight and tannage, prepare a mixture of five hundred and fifty gallons of pure cold water (soft water is the best), and six pounds of copperas, and suspend the sides or hides, if tanned whole, from rods in such a manner that they will be thoroughly immersed in the liquor, where let them remain for the period of thirty-six hours. The second step consists in removing the sides from the copperas-liquor and immersing them in a liquor composed by dissolving one hundred and fifty pounds of borax in five hundred and fifty gallons of pure water heated to 120° F., the sides being kept slowly moving in this liquor for the period of forty-five minutes, or until the leather feels slippery to the touch. In making the change into this liquor it it is best to put in at one time only so many sides or hides as can be conveniently kept in motion for the period stated, after which the sides are removed from the borax liquor and immersed in liquor No. 3, which is a mixture of fifty pounds of oil of vitriol or sulphuric acid and five hundred and fifty gallons of pure water heated to 115° F., in which mixture the sides are kept moving for one and one-half minutes, or until the desired color is obtained, after which the leather is quickly removed from the liquor and placed in a pool of clear running water, where it is left until all trace of the liquor has been removed, when the process is complete and the leather may be hung up to dry.

In making the change from the borax-liquor to the acid-liquor it is best to take only a few hides at a time, so that they can be quickly handled and not left to remain too long in the acid-liquor.

After the number of hides or sides stated have been treated with the several liquors in the manner described, the old liquors

should be thrown away and fresh ones made for the succeeding tannage; or, if preferred, the strength of the spent liquors may be raised to the standard by adding a sufficient quantity of the ingredients from which they are made. In order to insure the best results the strength of the different liquors, as also the length of time during which the leather must be left in them, should be slightly varied according to the weight of the leather and the degree of tannage. This must be left to the judgment of the bleacher, though the formula herein given, if strictly followed, will produce substantially the results claimed on any weight or tannage of leather. For the several liquors soft water or rain-water is best, although not indispensable.

In all the processes of union-tannage, light liquors are used to obtain the desired color, and consequently the weight is less than if heavier liquors could be used, and an advantage claimed for the process which has just been described, is that liquor of any required strength can be employed.

It is claimed that an expert cannot distinguish hemlock and union-tanned leather finished by this process from clear oak-tanned leather.

Section V. Artificial Sole Leather.

Large quantities of artificial sole leather are produced at Woburn, Salem, Peabody, and other places in Massachusetts, from leather scraps obtained from the numerous tanning and currying establishments in those places, and sole leather thus produced is much used in Lynn and other shoe manufacturing centres of New England, as well as in Chicago and other western cities, in the manufacture of cheap boots and shoes. In the different State penitentiaries where boots and shoes are manufactured, artificial sole leather is also much employed. This material forms the inside sole, and when it is used for heels one or two layers of good leather are nailed on the outside.

The following process for making from scraps and waste an artificial leather impervious to moisture, and to be used for soles and heels of boots and shoes, was patented in most of the Euro-

pean countries in 1882, and in the United States in 1883, by Emil Pollock, of Vienna, Austria-Hungary.

In carrying this invention into practice, the leather scraps and waste to be used in the manufacture are first assorted, and those which had been dressed or treated with oil or grease separated from those not dressed with oil. The former are placed in a bath composed of ninety-five parts of water and five parts of soluble glass (potash or soda glass) of 35° Baumé, or into a bath containing a proportionate quantity of soluble glass of 50° Baumé, as desired. The leather scraps or waste are allowed to remain in this bath, which may be cold or lukewarm, from one-quarter to one-half hour, according to the quantity of grease or oil contained in the scraps. The scraps are then drained off and placed in a solution of five parts of sulphate of zinc in five hundred parts of water. In this solution they are soaked for about half an hour. They are then pressed dry and ready for further treatment. In place of the soluble glass, any of the alkalies or any of the salts with alkaline reaction may be employed, and in place of sulphate of zinc, any salt the base of which forms an insoluble combination with acids may be used. The so-prepared leather scraps or waste are now mixed with a paste that is formed by a thin solution of starch, to which solution, while in a boiling state, a small quantity of gum arabic is added, and also to about twenty parts of the starch solution one part of a solution of alum consisting of five parts of water to one part of alum. The leather scraps are put into the starch and alum solution until they are thoroughly saturated. They are then, piece after piece, covered with a concentrated paste solution and placed in flat moulds in layers, one on top of the other, and beaten with hammers into sheets. The sheets thus formed are placed in a vessel containing a solution of soda soap, in the proportion of about one part of soda soap to two parts of water, and after having been well soaked therein they are subjected to hydraulic pressure, and finally dried, after which the sheets are ready for use.

By the above process the oil and grease contained in the leather scraps are saponified, and the soluble soap transformed into an insoluble one, which dispenses with the removal of the

grease from the scraps and produces the utilization of the grease in the formation of the insoluble soap, by which the leather is rendered water-proof.

The following chemical reaction takes place in the process described: The sulphuric acid of the alum combines with the soda of the soap, while the stearic and oleic acids,

$$\left(\frac{C_{18}H_{36}O_2, \text{ stearic acid,}}{C_{18}H_{34}O_2, \text{ oleic acid,}}\right)$$

which were combined in the soap with the soda, become free to enter into a new combination with the argillaceous earths of the alum, the hydraulic pressure favoring the most direct mechanical combination of the two salts. Consequently, the leather becomes thoroughly impregnated with sebate of alumina, by which it is claimed to be protected against moisture so as to be water-proof.

When leather scraps which contain no grease or oil are employed the saponification of the grease is dispensed with, and the scraps are mixed directly with the thin paste of starch and alum, and are then worked up with thick paste into sheets and treated in the same manner as the oil-dressed scraps, and finally exposed to hydraulic pressure, forming a tough, and as it is claimed, a water-proof leather that can be used extensively in the arts.

CHAPTER XXIX.

HEAVY UPPER LEATHER—TANNING AND FINISHING THE "SIDE" AND "SPLIT"—REMOVING EXTRACTIVE MATTER FROM TANNED LEATHER—PROCESS FOR WATER-PROOFING, DUBBING, AND WHITENING UPPER LEATHER—IMPROVEMENT IN TAN PRESSES.

SECTION I. TANNING AND FINISHING THE "SIDE" AND "SPLIT."

UNDER the head of upper leather are placed the soft and pliable leathers which are employed principally, but not exclusively in manufacturing the uppers of boots and shoes. Upper leathers are produced from such hides and skins as Patna and East Indian kips, light and heavy cowhides, Buenos Ayres and Rio Grande hides, calf-skins, horse-hides, and split heavy hides. The processes of tanning and finishing are more rapidly completed and less complex in proportion to the thickness of the hide treated, while at the same time, the percentage of tannin extract which the hide absorbs is likewise dependent upon its thickness.

Lime is generally employed to soften the bulbous roots of the hair, and thus facilitate its removal by mechanical scraping with a blunt-edged knife or by machines constructed for that purpose, which have been explained in Chapter XVI.

The lime used for upper leather must be removed in the preliminary stage of preparing the hide for tanning with greater thoroughness than is essential in the case of hides for sole leather; and for this purpose the hides are subjected to various treatments and in addition go through the process of bating or "grainering."

There is a great deal of obscurity surrounding the theory of the process of bating, but it has been explained on the supposition that the uric acid of the hen dung employed removes the

excess of lime, and that the ammonia generated by the putrefaction of the mixture tends to form an ammoniacal soap with any remaining fat of the hide; but as the gelatin of the hide exists in two states—one the principal, hard, or fibrous portion, and the other contained between the fibres, and which is more soluble and easily affected by agents and putrefaction—this softer portion is removed by bating, and the leather when tanned is light and porous, and more readily permeable by water, which is sought to be obviated by the subsequent stuffing of the leather with oil and tallow. In the preparation of most kinds of upper leather the heavier hides are split into two, and sometimes more portions. In the case of a single split the portions form a grain and flesh side; when three sections or slices are made they result in grain, middle, and flesh splits; the minor splits from shoulders, heads, etc., will be explained in the practical part of this chapter as they are reached during the progress of the hide into upper leather.

Some tanners split hides in the green condition, others after coloring, and in some cases the splitting is done by the currier, as a regular part of his operations, after the leather is fully tanned, this being particularly the case with imported tanned East India kips, and other fully tanned leather of foreign origin.

The fact that machinery is now largely employed by some tanners and curriers for nearly every mechanical operation, while others still adhere to the old system of manual manipulations of the hide and leather, will of course make it impossible for this chapter to apply to every case.

Then, again, some manufacturers employ machinery at one stage of the operation, while others reject it at that point and use it at some other stage. The machines described are those only that from personal knowledge we know to be acceptable in many instances by prominent tanners and curriers; the basis of description will be at Salem, Mass., and the manufacture of heavy quality of hemlock-tanned upper leather is that which we will consider. In the city of Salem, and its adjoining neighbor Peabody, is produced a large quantity of upper leather, the hides used being mostly foreign, but some domestics in all con-

ditions are also employed; they are kips, light cows, and heavy cows.

A large number of hides have lately been brought from China; all the states of South America send hides to Massachusetts, east and west coast of Africa hides are also used, California hides are also employed, and Mexico sends them in moderate quantity, but South America furnishes the largest number. The bark used for tanning is usually hemlock, being derived mostly from Canada; but Maine also ships hemlock bark in schooners, and it arrives in Salem in a less broken condition than that received from other localities. Pennsylvania also furnishes some bark to Salem, and extracts of bark are also employed there for tanning, but only in small quantities.

In the State of Massachusetts the bark is nearly all bought by the cord, but some of the large tanneries purchase by weight.

Preparation of the Hides.

The hides first go into the "soaks" of clear cold water, and the period which they remain here is of course dependent upon the kind of hide, and varies from one to three weeks for those in a dry condition. Soft water is preferred for the "soaks" for upper leather, as the hides must not be swelled as much as those for sole leather, as otherwise the smooth cut would be injured.

After they are split into sides, previous to which the hides are drawn into a pack, the hair side being placed uppermost, a knife is driven from the butt through the centre of the back. The sides are then placed in the hide-mill, which is a machine constructed similar to the fulling-mill used in woollen factories, and the time which they remain in the mill varies from one-fourth to three-fourths of an hour, the period being dependent upon their hardness or softness. Green salted hides are not of course worked in the hide-mill.

From the hide-mill the sides are placed in clear cold water and remain over night, which period is sufficient if the first soaking has been properly done. Sometimes the sides are re-placed in the same water from which they were taken previous to going into the hide-mill, and this hastens the process of de-pilation; but this results in loss in the end, as they cannot

develop into properly plumped leather, and of course do not give profitable splittings.

From the last water they are removed to the "limes," and there remain until the hair is well loosened, after which they are unhaired, and this operation is now done either by hand or machinery. The style of machine commonly employed in Salem, Mass., for unhairing, is shown in Figs. 100 to 104.

After the sides are unhaired they are placed in clear water and on removal are "green shaved," which is the removal of the loose flesh from the hide. Then the heads are run through the splitting machine, and the sides are next placed in the drench, and are worked about eight or nine hours in the bate, which contains hen manure. The object of the bating, as has been explained, is to neutralize the lime, open the pores for the admission of the tanning liquor, and also to render the leather more pliable. Pure cold water will extract the lime from the hide, but it leaves it much rougher and harder to finish than when hen manure is used.

After being removed from the bate the sides are placed in the wash-wheel and worked for about fifteen minutes. The drench-wheels and wash-wheels are shown in Fig. 112.

The period which the sides remain in the bate depends upon their thickness, the temperature of the bate, and the season, usually longer in winter than in summer. The sides then go to the hide-working machine, and here they are freed from lime and dirt, and are next thrown into clear spring water, where they remain over night.

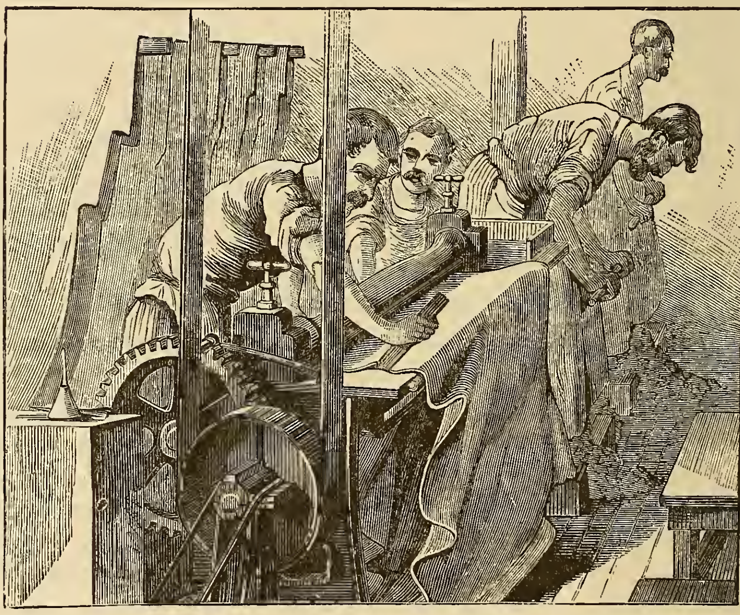
The style of hide-worker employed has an eccentric motion, and is shown in Figs. 114 and 115. The hide has thus, by these preliminary operations of removing the portions not required for use and the cleansing, been prepared to receive and absorb the liquor in which the tanning matter is dissolved.

Tanning.

The sides are now placed in the handling liquor, which is a weak mixture, and remain in it for ten or twelve days for heavy upper leather, and during this period they are hung on sticks in the vats, and are afterwards twice "laid-away" in

ground bark, both lay-aways usually extending through a period of about two months, the first lay-away being for ten or twelve days, and the second consuming the remainder of the period. When removed from the lay-away the sides are hung on poles in the drying yard for a day to harden, and are then brought into the cellar and dampened. Fig. 226 shows the sides of leather hung over the poles, in the drying yard facing the finishing shops. The sides are next split. A day's work for one man on the union machine is about two hundred sides of leather. The operation of splitting the sides for upper leather consists in reducing them to a uniform thickness.

Fig. 227.



When the belt knife machine is employed the entire surface of the side is passed through in one operation, but the union machine usually requires two operations. The split is used for the tops of shoes or backs of boots, the splits are carried to a table and trimmed, which is the lopping off of the rough edges, and they then follow the other leather through the process of

Fig 226. Drying-yard of an Upper-leather Tannery—looking towards the Finishing-shop. Page 496.

tanning. The shoulder is also passed through the splitting machine; but the shaving is not tanned, and is sold for stiffening stock, and is also largely used in cheap or shoddy shoes by what are termed "pan-cake shops," which are places where boots and shoes are made for looks more than for wear, though the better part of these skivings are used for stiffenings and the lighter ones for "insoles." The splitting machine, etc., are shown in Fig. 119, and are described in detail in Chapter XX. The sides next go to a "flatter," who levels off the shanks and bellies with a currier's knife, as shown in Fig. 227, and they are then carried to the tanyard, and placed in a revolving wheel to be softened, twenty-five sides being placed in the wheel at one time and moderately strong gambier liquor poured over them, and in this wheel they are milled for about ten minutes.

The result sought to be attained in placing the sides of leather in the mill after they have been split is to prevent the "glazing" or "crusting" of the raw parts from which the split has been taken. They next go back into the handlers and are drawn each day, and the liquor renewed; they are not hung upon sticks in the handlers this time, the sides being pressed down and the liquor allowed to flow over them, and the period which they remain here is about fifteen days.

Finishing the Side.

From this last liquor the sides are carried to the shop and scoured, which may be accomplished by hand, as is shown in Fig. 137. The machines employed for this work, as has been stated, are the Burdon Scourer, the Fitzhenry, and the Lockwood, each of which is fully described in Chapter XXI. From the scouring machines the sides are again taken to the poles or yard shown in Fig. 226, for hardening, and from thence are carried into the cellar to be dampened, about two days being occupied in the tempering.

They then go into the stuffing wheel, as explained in Chapter XXII., and the sides remain in the wheel for about fifteen minutes, the grease being here driven into the leather by heat. Fifty pounds of grease are used to two hundred pounds of leather, *i. e.*, for heavy upper leather; boot leather requiring a greater quan-

tity of grease, the leather must be warm and be kept warm uniformly during the time the grease is being applied to it.

The stuffing wheel in operation at the establishment of Thos. E. Proctor, located at Peabody, Mass., seems to do this work more thoroughly than any other that has been inspected by the author. This stuffing wheel is shown in Figs. 160 and 161.

The leather, after being removed from the stuffing wheel, is then set out on the improved Fitzhenry or Lockwood machines, which have been illustrated and described in Chapter XXI.

The number of sides of heavy upper leather which can be set out on the improved Fitzhenry machine is about two hundred and seventy-five per day; but three hundred and twenty-five sides of lighter leather can be set out by the machine in the same time.

The next step in finishing upper leather is that of whitening, which process can be performed by going over the leather on a table with the slicker, or the surface can be cut over with a currier's knife, or the whitening can be done by a machine, improved forms of which are shown in Chapter XXIII.

The leather is then "stoned out" on a jacking machine, and if it requires softening it is next boarded by a machine, as shown in Figs. 177 to 182.

The sides are now carried to the blacking loft and the flesh side is there "blacked" with soap blacking. This flesh blacking is made in two ways, sometimes with lampblack and soap, and at other times with lampblack and oil. When "soap blacking" is employed, oil is very freely applied afterwards in order to fasten the color and body of the black.

It is claimed for soap blacking that it fills the flesh with a better body and hides defects in the leather which show through if oil and lampblack alone are employed. For other blacking compounds, see Chapter XXV., Section II.

The disadvantages urged against soap blacking are that when this leather is crimped for boots, the blacking washes off leaving a coarse surface, while the alkali contained in the soap will, if allowed to lie for some time, neutralize the grease, thus imparting to the leather a harsh feeling; pure oil blacking, on the other hand, will gradually grow softer with age.

Soap blacking is not now much used in foreign countries, and it is only used by us in the modified form to which attention has been invited.

The blacking is applied with a wet brush and thoroughly rubbed into the leather with a dry brush in the hands of the workman.

There are machines for performing this work, as shown in Figs. 185 to 196; but they are not thought to answer so well for heavy upper leather as for softer and lighter leathers.

The next operation is that of glassing, and this can be done either by hand or machinery, and when performed by a machine the same style is commonly employed as is used for rolling, pebbling, and finishing leather, but the improved Lockwood and Fitzhenry machines are also used.

The Martin machine is largely used for glassing upper leather, and it is shown in detail in Figs. 200 to 203.

After the side has been "tempered" it is again glassed, and then "pasted."

Flour paste is used for the last operation, which is made from flour, with soap added, say in the proportion of about two pounds of hard brown soap to every pail of flour used, the soap being boiled with the paste. A piece of tallow about the size of an egg and a small piece of wax are also added to each pail of flour and also boiled with it.

This composition is to "fill" the leather and make the stock "fine."

After the leather is "pasted" it is dried and then "glassed in paste," which operation is also usually performed by the Martin Glassing Machine.

The side is next "sized" with a preparation of gum paste applied to the flesh side with a sponge in order to finish.

The "size paste" is made by dissolving four ounces of pure glue in warm water, adding a small piece of tallow, say half an ounce, and then diluting with water until the desired consistency is reached, when it can be easily spread with a sponge.

After the application of the size the leather is hung up and dried, then assorted and finally measured, marked, and bundled for market. An interior view of the finishing room of an upper

leather manufactory showing the pasting tubs and tables, horses for receiving and moving the leather and the blacked and pasted sides suspended from hooks in the ceiling racks, is shown in Fig. 228.

There are several ways for measuring leather. The old-style measuring frame is still largely employed; but later inventions for measuring leather are illustrated and explained in detail in Chapter XXVII.

Finishing the Split.

There are two processes for stuffing the split: if hand stuffed, it is taken from the scouring machine and stuffed; but if wheel stuffed it is handled about the same as the grain, after which it is struck out, dried, whitened, and trimmed.

There are also two methods for finishing a split: if a flesh split it is whitened on the flesh side; but if a waxed split it is finished on the split side.

No preparation is applied to the back of the flesh split, it being left plain; but the waxed or colored split is stained on the flesh side, and it is strictly known as the "colored pebble," of which there are two colors, the oak and hemlock, the first being a yellow and the second a red.

The process of "fitting" the colored split is as follows:—

1. Coloring.
2. Drying.
3. Boarding.
4. Glassing.
5. Pebbling.

The machine shown in Figs. 206 to 208 is largely employed for the last-named operation.

After pebbling, the colored split is ready for the "blackers," and the process from that stage is similar to finishing the "side," which has already been described at length.

Head's Process for Soaking, Liming, Tanning, Blacking, and Gumming Hides Intended for Upper Leather.

Head's process is as follows:—

The first step consists in soaking the hides, as they are removed from the animal, in a vat of water about eight feet long,

Fig. 228. Interior View of the Finishing-room of an Upper-leather Manufactory. Page 500.

four feet wide, and four feet deep, into which has been poured a mixture of one-half pound of saltpetre, one pound of potash, one pound of oil of vitriol, and twenty pounds of rock salt. This solution preserves the hides from decomposition, prevents the gelatine from dissolving, and assists in the liming process. They remain in soak from one to two hours.

The second step consists in fleshing the hides after they have been soaked.

The third step consists in placing the hides in a vat of water of about the dimensions given above, into which has been poured a mixture of one bushel of quicklime and one and one-half pounds of sal-soda. By the use of this mixture it is claimed that the time necessary to lime the hides is shortened to about six hours. This solution rapidly removes the albuminous substances which hold the hair.

After the hides have been taken from the lime above described, they are ready for the fourth step, which consists in soaking them in a vat of water at a temperature of about 110° F. They are allowed to remain in this vat about two hours, though a shorter time will accomplish the purpose as well.

The fifth step consists in removing the hair and lime-shaving the hides.

The sixth step consists in scouring them upon the grain side to remove all foreign substances, and prepares them for the coloring liquor. It is seen that after the hides have been lime-shaved they are not placed in a bate, as is usually done, but are immediately scoured. This method, it is claimed, prepares them for the tan better than the process in common use.

Seventh, the hides are placed in the coloring liquor, and remain until they have acquired the desired color, which can be ascertained by watching them, and when removed from this liquor the hides are immediately scoured, which removes all sediment and unnatural grain, and constitutes the eighth step of the process.

Ninth, the hides are spread out on a table or floor, and the tanning solution well rubbed in with a brush or swab, and then laid away in a pile, which is the tenth step, the time which they remain in the pile being from two to fifteen days, according to

the character of the leather to be tanned. While in the pile the hides are handled once a day or oftener, more of the solution applied, and the hides returned to the pile. If, however, it is desired to retain the color upon either side of the hide, the tanning solution is applied to the opposite side from that upon which the color is to be retained, the solution is well boarded in upon that side, the hides folded together separately with the side which is to retain the color outward, and replaced in the coloring solution. If it is desired to retain the color upon both sides of the hide, the tanning solution is applied to both sides, is well boarded in, the hides spread out flat, and returned to the coloring liquor. The hides remain in this liquor from two to fifteen days, according to the character of the leather to be tanned. While undergoing this process the hides are handled once or twice a day, scoured, more of the solution applied, and returned to the liquor.

The eleventh step, which consists in "sammying" the hides, is then carried into effect.

The twelfth step consists in scouring them on both sides, the thirteenth step in setting them out on a table or floor and flattening them with a slicker, and hanging them up to dry. When the hides have become dry they are taken down, placed upon a table or floor, and stuffed, which constitutes the fourteenth step.

The fifteenth step consists in packing the hides down in a pile and covering them up to protect them from currents of air and from the light, which allows the stuffing to penetrate them without injury to the color. The length of time the hides remain in the pile is optional, though the shortest time necessary to obtain good results is two hours.

The sixteenth step consists in dipping the hide singly in a vat of water at a temperature of about 120° F., which completely drives in all the stuffing previously applied. After the hides have been dipped they are immediately struck out and hung up to dry, which is the seventeenth step.

The eighteenth step consists in whitening, trimming, and boarding them after they have dried, and by which they are made ready for the blacking.

The nineteenth step consists in blacking the hides, and the inventor does this with a composition of one pound of lamp-black, one and one half pounds of Babbitt's soap, boiled together in three gallons of water. The advantages claimed for this composition are that it softens and improves the texture of the leather, or, in other words, makes it "mellow." It is claimed that Babbitt's soap gives the best results for this purpose.

The twentieth step consists in smutting the hides off and applying oil and gum tragacanth to them.

The twenty-first step consists in glassing them down and hanging them up to dry.

The twenty-second step completes the process, and consists in gumming them off with clear gum tragacanth after they have dried.

Section II. Removing Extractive Matter from Tanned Leather.

In 1879 Plumer and Kernans, of Peabody, Mass., patented the following process for removing extractive matter from tanned leather: By this method leather tanned by the hemlock, oak, or other usual processes is subjected to a cleansing bath, which removes the extractive and tanning substances, grease, tannate of lime, etc., added to the hide during the liming, bating, and first tanning processes; especially such matter as would tend to make the finished leather hard, or brittle, or which would interfere with giving to the grain-face of the finished leather a light, even color. This the inventors claim to accomplish in the following manner: The tanned leather, say, twenty-five sides, containing from twenty to twenty-five feet each, are subjected in a mill to the action of diluted solution of borax for from ten to fifteen minutes; for the quantity of leather mentioned about six pounds of borax are dissolved in about thirty gallons of water.

In practice the best results are obtained by the use of a closed circular or box-like wheel of about eight feet diameter by two or three feet in width, and having a hollow journal for the entrance of a water or steam pipe, and a side door for the intro-

duction and removal of the leather, the door to be suitably packed to obviate leakage.

Having added the borax-water to the wheel, and placed the tanned leather therein, the wheel is rotated at the rate of about sixteen revolutions per minute for about fifteen minutes or until the objectionable matters referred to are loosened, when a hose or other water supply pipe is added to the hollow journal of the wheel to lead water into it, and in contact with the leather, so as to wash out the borax and other matters loosened or started by the first milling operation in the borax water. This treatment, it is claimed, leaves the leather in proper and the best possible and most favorable condition to be retanned for all leather where softness and lightness of color are desired.

Section III. Processes for Water-proofing, Dubbing, and Whitening Upper Leather.

Rady patented the following process for water-proofing, dubbing, and whitening upper leather, the object being to give the leather a "satin finish."

The process is as follows: A rough-tanned skin is first soaked, shaved, scoured, and then retanned, and next scoured and dubbed with oil and tallow, and then whitened, after which it is water-proofed by the following process—which is the first point of the combination where this invention commences.

For the first part use a compound which consists of one part of dry gelatine (isinglass or other) dissolved in four parts of oil including a small quantity of sulphuric or other acid, and, when these are combined by means of heat, five parts of an alkaline solution are added, at a specific gravity of about 26° Baumé, the whole being stirred while yet warm, and the result is a chemical combination designated as "the preparatory compound."

For the second part of the process use the compound which is designated the "perfecting compound," prepared as follows: In one vessel prepare a strong solution of one of the alums (for instance, of the sulphate of alumina) with potassa, ammonia, or soda. In another vessel prepare a solution of the sulphate

of zinc, and in a third vessel a solution of the acetate of lead. These solutions are each to be of the same density. When prepared, the two sulphate solutions are mixed in the proportions of about five parts of the first to one and a half parts of the latter, and to these are added about five and a half parts of the acetate-of-lead solution. By the chemical action that ensues sulphate of lead is formed, and when this has subsided the clear liquid is drawn off, and is reduced to the proper density, which is from 1° to 2° Baumé.

The manner of treating the material to be water-proofed is as follows: A bath is prepared with half an ounce of the preparatory compound dissolved in two gallons of hot water—that is, in about these proportions—and is used when cold. To treat leather, steep it in this bath till indued with its properties, and then drain it; or the preparatory compound may be dissolved to about the consistency of cream, and then applied by hand before the "stuffing."

Boots, shoes, and harness are treated before the final finish.

The second part of the process is conducted as follows: When the goods have been removed from the preparatory bath, and are well drained, steep them in a bath of the "perfecting compound," where they remain from eight to twelve hours, and when well drained, they are gradually dried, which completes the water-proofing.

After the water-proofing the side or skin is dubbed with tallow and oil, after which it is whitened, and then finished.

The final combination of dubbing, whitening, water-proofing, etc., it is claimed, gives the leather a superior finish.

Sponhouse's Method for Manufacturing Water-proof Leather.

In the selection of hides take those which are dry, as green hides are more porous. A solution of lime is made, care being observed not to make it too strong, for if too much lime is used it will swell the leather, and thus render it porous, soft, and spongy. The leather is then placed in the solution, as ordinarily, and when all animal or extraneous matter has been expelled therefrom, it is bated low in the usual manner with the proper decoction, in order to extract the lime as clean as

possible, so that the tannin will penetrate it. The upper leather and kip hides are handled in sweet liquor only, as sour liquor will swell them. When about three-fourths tanned, the leather is shaved and thrown into sour liquor and allowed to remain for a week. The leather during that time is handled every day, and taken out and scoured a little, after which the flesh side is stuffed with dubbing applied milk-warm, composed of the following ingredients: Tanner's oil, 4 parts; flaxseed oil, 1 part; tallow, 2 parts; care being taken not to stuff the leather too thick or heavy with the dubbing. The leather is then folded up tightly and put into a close box and allowed to remain for 48 hours, so that the stuffing will enter the pores. A strong solution of bark is made in a vat, in which the leather is then placed with the flesh side down, in order that the solution will tan in from the grain side. By this operation the stuffing and the oil will be tanned with the leather. It is then permitted to lie in the vat about 6 weeks, when it is taken out and scoured and allowed to get about half dry. The following ingredients, with the proportions of each given, are then mixed and applied milk-warm to the leather, viz: tallow, beef or sheep, 1 pound; tanner's oil, $1\frac{1}{2}$ pounds; beeswax, 3 ounces; castor oil, 4 ounces. The leather is then again tightly folded and put into a close box and allowed to remain 48 hours. The same dubbing, composed of the above ingredients just mentioned, is stuffed on the grain side for wax finish, and the same again applied on the flesh side for grain finish, pure tanner's oil being used for this side. For the finish, or blacking for wax finish, take lampblack, one pound, and apply dubbing again on the grain side. The following ingredients are mixed with those herein above described, viz: beef gall, 1; India rubber, $1\frac{1}{2}$ ounces. Oil enough is added to make the same of the proper consistency. The rubber must not be dissolved in alcohol or spirits of turpentine, as it will injure the leather, but cut into strips and ignited, and the oil collected therefrom used. In the dubbing this will make a fine finish.

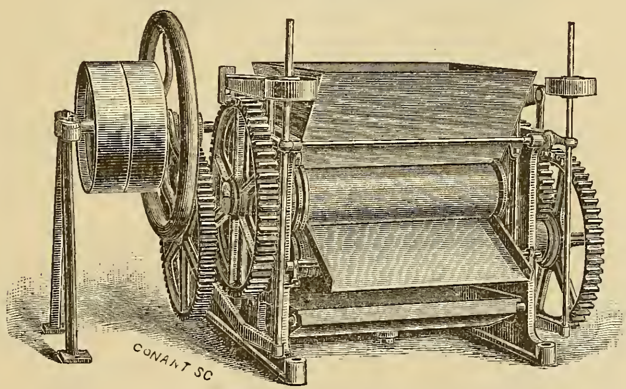
The ingredients herein described, and as combined in the manner in which they are used and applied in the process of tanning, constitute Sponhouse's water-proof composition for

leather. The composition is applied the same as other blacking to a boot or shoe, and will not only give a fine polish to it, but keep it soft and pliable, so as to make it easy for the foot.

Section IV. Improvements in Tan Presses.

In the present state of knowledge on the subject it may appear idle to speak of the economy of a tan-press over drying the spent tan in the sun, or on the top of a boiler, or having it carted away as waste. By means of an elevator, consisting of buckets on an endless belt, the spent tan is taken from some convenient depository near the vats to a bin above the tan-press; it feeds itself through, and is from there deposited in front of the boiler, where it is ready to be burned, thereby saving all labor except the little of getting the tan to the place where it is first taken up by the elevator. Thus there is obtained a good fuel convenient for use at almost no cost.

Fig. 229.



The furnaces in sole-leather tanneries are usually so constructed as to burn wet spent tan; but in upper-leather tanneries the material has to be treated so as to have it as dry as possible.

The tan-press shown in Fig. 229 is manufactured by the estate of Charles Holmes, Boston, Mass., in two sizes, one size having 36 inch rollers and the other 28 inch rollers, the speed being about 165 revolutions per minute. This machine will

press from 15 to 18 cords of spent tan in ten hours, with three horse power, and leave the material sufficiently dry for fuel.

Fig. 230 shows a perspective view of the W. K. Daniels tan-press, which is manufactured in Salem, Mass. This press is made in two sizes, the smaller of which will press eight cords of spent tan in ten hours, and the larger, twelve cords.

Fig. 230.

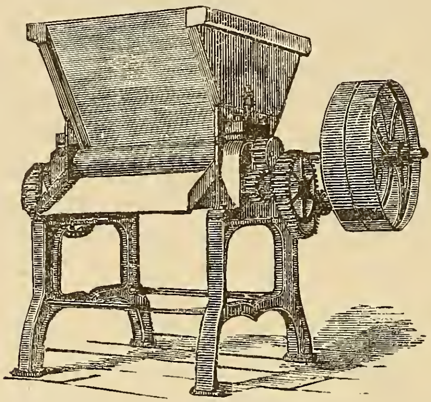


Fig. 231 is a central vertical longitudinal section of the tan press invented by Thomas F. Weston, of Salem, Mass., and which is commonly known as the "Salem Tan Press." Fig. 232 is a front view of the forward rollers of the same.

The gearing and driving-wheels are not shown in the drawings, as any arrangement of well-known mechanism may be adopted for rotating the several rollers as desired.

A represents the frame of a machine, having on each side a forward, upright, slotted, or open standard, *B*, provided with suitable boxes, or otherwise arranged to receive and allow the rotation of the axles or ends of an upper pressure-roller, *C*, and an under delivery-roller, *D*, provided with suitable gearing or other mechanism for rotating them in contrary directions with eath other. Provided with suitable gearing, or otherwise arranged to rotate in the same direction with the delivery-roller *D*, is a feed-roller, *E*, the ends or axles of which turn in boxes connected with the sides of the machine. The roller *E* is located

at a sufficient distance in the rear of and below the forward pressure-roller C to leave adequate space to receive the tan, and at

Fig. 231.

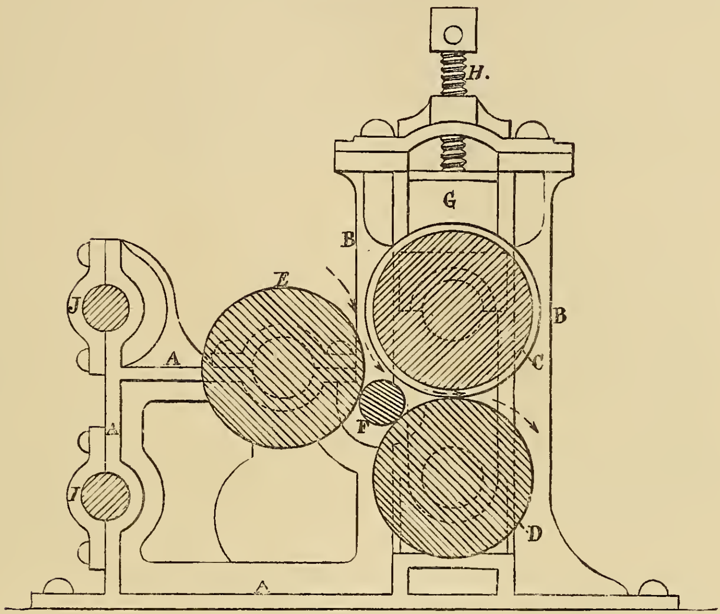
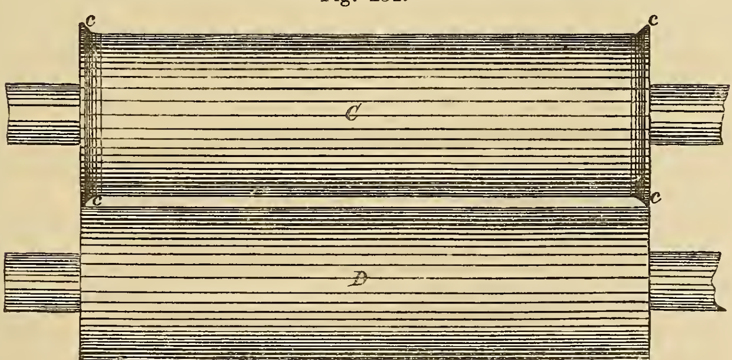


Fig. 232.



a sufficient distance from the upper rear portion of the delivery-roller D, and rotating in the same direction with it is a supple-

mentary smaller roller *F;* between each roller *F* and the pressure-roller *C* is left a sufficient space for the passage of the tan.

The space between the feed and delivery rollers being filled by the supplementary roller *F* prevents the falling through of the tan or other material, which is assisted in its passage and pressed against the pressure-roller *C* by the rotation of the roller *F*, which is arranged to turn in the machine, and is provided with a gear-wheel meshing with the gearing operating the feed-roller *E*, or otherwise provided with suitable mechanism for rotating it in the same direction with the said roller *E*. The gearing or other operating mechanism may be arranged to be actuated by steam or other motive power. The pressure-roller *C* is arranged to have a vertical movement in the standards *B*, regulated by rubber or other suitable springs *G*, adjusted by screws *H* turning in the heads of the standards *B;* or the pressure-roller *C* may be otherwise arranged, as desired, to have a yielding bearing or movement, or to be adjusted to admit of its operation on different thickness of material or matter. Any or all of the rollers may be corrugated or plain on the periphery, as desired. *I* is a driving-shaft, and *J* a shaft carrying gear-wheels meshing with suitable gearing, operating the several rollers to carry the same in the direction required.

The pressure-roller *C* is formed at each end with a lip, *c*, curving up from the periphery of the roller to the rim of the lip, as shown, to close the space between the rollers *C* and *D* at the ends, and compress the tan or other material at the corners of the roller, so as to fill up the same and prevent the passage of liquid at these points, which passage is otherwise often apt to occur, owing to the tan not properly filling in at the ends of, as it feeds to, the roller.

The operation of this machine is as follows: Power being applied to revolve the rollers, the tan is deposited at the top between the pressure-roller *C* and feed-roller *E*, and carried between them, forming a sheet, which is taken by the supplementary roller *F*, and carried along and against the pressure-roller *C*, which presses it upon the feed-roller *E*, between which rollers it is passed and delivered from the machine through a hopper, or into a receptacle, or as desired, comparatively freed

of liquid, the supplementary roller *F*, turning snugly between the rollers *E D*, preventing the passage of the tan between the rollers, and assisting in its passage and pressure, and the lipped formation of the roller ends *c* preventing the back passage of the liquid, as will be readily seen by the above description, and on examination of the drawings without further explanation. The liquid expressed from the tan flows downward between the small roller *F* and rollers *E D* into a suitable receptacle, the narrow space between said rollers allowing the passage of the liquid, but not of the tan.

CHAPTER XXX.

GRAIN, SPLIT, AND BUFFED LEATHERS—TANNING AND FINISHING GRAIN SPLIT AND BUFFED LEATHERS—COMPOUNDS FOR PRODUCING IMITATION OF GRAIN AND MOROCCO LEATHER.

SECTION I. TANNING AND FINISHING GRAIN, SPLIT, AND BUFFED LEATHERS.

THE above varieties of leather are produced in large quantities in this country, Woburn, Mass., being one of the chief centres for their manufacture.

The bark used at that place is hemlock, and is derived from Canada; the sumach employed is both imported and native.

The hides used are chiefly green salted, and are obtained from St. Louis, Mo., Cleveland, Dayton, and Cincinnati, Ohio. Boston, Mass., and other points in New England furnish a few hides, but the supply from the latter sources is small.

The hides used for the varieties of leather under consideration are "buff hides," *i. e.*, those obtained from cows, heifers, and steers, and weigh about 50 lbs. each.

The first step in preparing them for the tanning liquor is to place the hides in the "soaks" of clear, cold well water, and here they usually remain for four days.

After being removed from the soaks, the hides are split into sides in the same manner as has been described for heavy upper leather, and after being split the sides are placed in the "limes," where they remain for six days, being reeled into a vat of stronger lime each day.

The sides are next unhaired, which is accomplished both by the hand and machine process, one hundred sides being a day's work for one man by the first method, while eight hundred sides of leather can be unhaired by two men in one day of ten hours by the machine method.

When unhaired by machinery the sides are passed through a McDonald or other suitable unhairing machine, and are then, by some large manufacturers of these varieties of leather, thrown into a vat containing sulphuric acid diluted with water, from which they are immediately dipped out by an oscillating framework of wood, the time which the sides remain in this dilute sulphuric acid bath being not longer than one minute. The sides are then passed through a second McDonald or other suitable unhairing machine, and any hair that may still remain upon the edges is dressed off on a beam with an unhairing knife by a workman.

In this way eight hundred sides are unhaired in a day, and the wages of six workmen are saved. The unhairing machines are fully explained and illustrated in Chapter XVI.

When the sides are unhaired in this manner by machinery and subjected to the dilute sulphuric acid bath, as soon as they are dressed off by hand at the unhairing beam, they are thrown into a vat containing clear, cold, spring water.

After remaining in this cold water for a short time, the sides are removed, and tacked to sticks and placed in the "handlers."

This seems to be pushing things a little too rapidly, but the method is pursued by some of the largest manufacturers of buffed leather in the State of Massachusetts, who appear to have difficulty in making sufficient leather to meet the demands of their trade, while other manufacturers, who give more care to the stock which they produce, find it difficult in competing for a market.

There is no doubt that a much larger quantity of lime is

removed from the sides by passing them through the unhairing machines, which also scour the sides, than could possibly be removed by hand. Whether it is good policy to hasten the preparation of the side by the method which has been described, is of course not the province of this volume to decide, and should be settled by each tanner to his own satisfaction, taking individual experiences as a guide.

Our large home consumption of leather and our constantly increasing export trade make it imperative to take advantage of every oportunity to hasten the production and lessen the price of this material, when it can be done without serious injury to the quality. If the method of unhairing by machinery and then subjecting the sides to a bath of sulphuric acid diluted with water, and then placing the side in cold water as described, answers all the requirements, then we think no objections should be urged against it.

But to return to the point of divergence: After the sides are unhaired by the hand process they are placed in a bate of hen manure in which they remain from twelve to thirty-six hours, but when the sides are worked in the bate with the England wheel shown in Fig. 112, the bating can be accomplished in six to eight hours, the time depending upon the weight of the hide and other circumstances, the object of the bate being to fully neutralize the lime, thereby allowing a smoother finish to be applied to the leather.

After being removed from the bate the sides are allowed to remain over night in a vat of clear, cold spring water, and are tacked to sticks and suspended in the "handlers" containing hemlock liquor, which is increased from about 6° strength at the start to 12° strength at the finish. The sides are treated in these handler vats for about twenty-four days, being shifted every third day into stronger liquor.

After being removed from the sticks they are hung over poles and dried in the open air, as shown in Fig. 226, and are next carried into the shop and skived usually by a belt-knife machine shown in Figs. 132 to 135; one man being enabled by means of a machine of this character to skive 400 sides in one day of ten hours. After being "fitted" or trimmed on a table

with an ordinary shoe knife they are next "split" usually by the same kind of belt-knife machine which has been mentioned. Two men will split 400 sides in one day of ten hours. About $4\frac{1}{2}$ ounce grain to the square foot is usually taken off the side in splitting it.

The "split" is then trimmed by hand, and placed back in liquor of about 8° strength, which is gradually increased, and remains for from twelve to fifteen days.

The part from which the "split" is taken, called the "grain," is shaved on a beam with a currier's knife in order to make the side of uniform thickness. One man will shave from 60 to 70 sides in a day, the number depending upon their size and condition.

They are then "milled" with sumach liquor for about one hour in a revolving drum, which is commonly about seven feet in diameter.

The sides are then placed in sumach liquor of about 8° strength, which is gradually increased, and remain for about sixteen days.

For these leathers the American and Sicily sumachs are not mixed, as for Morocco leather, but are usnally employed separately.

After being removed from the liquor they are next scoured, which is done either by hand or machinery; if done by hand they are placed on a slate table, as shown in Fig. 137, and scoured first on the flesh, and then on the grain side. The tools used in this operation are the ordinary scouring brush, slicker, and stone, and by this method one man will scour fifty sides in a day.

After being scoured, they are hung over poles and exposed to the air to harden, and are then carried to the shop and stuffed in a revolving drum, such as has been explained and illustrated in Chapter XXII.; the operation of stuffing lasting for about fifteen or twenty minutes.

Fish oils, paraphine, oleine, and rosin are employed in the stuffing compound used for the "grains," and tallow, fish oils, and rosin for stuffing the "splits."

The sides are next "set out," and after that are carried to the finishing-room and blacked on the grain side with a preparation

of logwood and copperas for the "grains," lampblack and soap being used for the "splits."

The "splits" are immediately "glassed" on a machine such as is shown in Fig. 199, and then placed on a horse for convenience of moving to the hanging up hooks, as shown in Fig. 228. One boy of nineteen or twenty years of age will glass six hundred "splits" per day.

The "splits" are next "pasted" with a preparation of flour paste placed on the top of the blacking on the grain side.

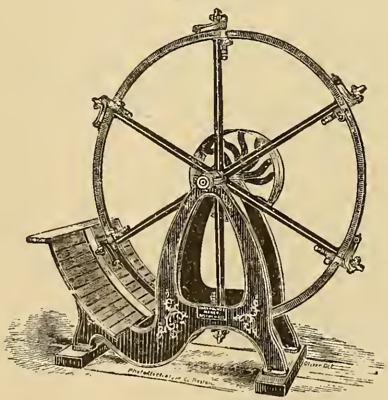
They are then hung up in the finishing-room and allowed to dry over night, and in the morning are reglassed, and are then immediately finished by gumming them over with gum tragacanth dissolved to about the consistency of jelly. Sometimes a preparation of fish oil and rosin is applied, which application depends upon the softness of the leather after being gummed.

The "splits" are then assorted for different weights, and are measured and rolled up, ready for market.

Finishing Grain Leather.

The "grains" having been blacked, as has been described, are hung up in the finishing-room and dried, after which, if the

Fig. 233.



side is to be "pebbled," it is carried to the "jack" and pebbled on the grain side, after which it is grained on the grain side with an armboard shown in Fig. 243. The sides are next pol-

ished on the same side by means of a revolving wheel; the pattern shown in Fig. 233 being largely used for this purpose.

After being polished, the sides are again grained with the armboard, and immediately oiled with a mixture of fish oil and paraffine, and then measured for market. In graining "pebbles," the sides are "cut" four ways, the same as for Morocco leather.

The "straight grains" are finished in the same manner as the "pebbles," except that a different roller is used in the "jacking machine," and in graining they are "cut" only from one direction.

Finishing Buffed Leather.

After the leather has been scoured either by hand or machinery, it is then hung on poles in the open air to harden, after which it is "set out" on the grain side with a stone so as to make it solid, and free it from the grain, and it is then stuffed. This variety of leather is often stuffed by hand, and it is performed by laying the side of leather on a table, flesh side up, as shown in Fig. 137, and working over it with a steel slicker, after which a preparation of fish oil and tallow is applied with a brush to the flesh side. The sides are then hung up in the loft to dry, being placed on sticks in tiers, and in this manner they remain suspended usually for about three days.

The superfluous grease is then removed from the flesh side by means of a slicker; but sometimes this operation is performed by a machine, which is called by the curriers a "grease jack," and is shown in Fig. 164.

The leather is now in condition for buffing, which, when done by hand, is performed by placing the side on a slanting table covered with leather, and removing the grain by means of a whitening or buffing slicker, which is shown in Fig. 165. One man will buff from fifty to seventy sides of leather per day, the number varying with the condition of the leather and the skill of the workman. The machines used for whitening and buffing leather are shown in Chapter XXIII. In order to improve the appearance of the edges, the sides after being buffed are next trimmed around with a common shoe knife.

They are then placed on a flat table, fifty sides being piled

one on top of another with the grain up, and the batch is then blackened with a composition of logwood and water boiled together, which is rubbed into the leather with an ordinary blacking brush, samples of which are shown in Figs. 184 and 185, or the sides may be blackened by machinery.

After the pack has been thus treated the sides are then blackened with another compound of iron rust and copperas.

The sides are then replaced upon the table, flesh to flesh, and are then "smutted," which operation is performed usually by working over the blacking with a woollen cloth in order to remove dirt and sediment, and improve the appearance of the blacking.

Bryant's machine for "smutting" leather is shown in Figs. 196 and 197.

The leather is next glassed in order to make it "fine" and remove all the creases, and when the glassing is done by hand the side is placed on a table and the blacked portion worked over with a glass slicker. The sides are then hung up in the finishing-room for a short time, and then "pasted," which is an application of flour paste over the blacking, and commonly put on by means of a sponge. After being thoroughly dried, the sides are "soft-boarded" by working them with the flesh side up, and one man will soften about one hundred sides per day.

The leather is then laid upon a table and slicked off clean on the flesh side, and then immediately glassed on the grain side, after which it is gummed with a preparation of gum tragacanth made of about the consistency of jelly, and applied over the paste.

The sides, after being hung up and dried, are then assorted, measured, marked, and bundled, and the buffed leather is then ready for market.

CHAPTER XXXI.

GERMAN HARNESS LEATHER—VACHE-LEATHER—MACHINE BELT LEATHER GREASED WITH TALLOW.

Green hides, if possible, are used for these varieties. As many hides as can be placed in the lime pit are, after cutting out the horns, soaked in running water six to eight hours with frequent rinsing, next cleansed from dung and placed in weak milk of lime for twenty-four hours. They are then taken out and replaced, after preparing fresh lime, for twenty-four hours more, when they are again handled. After this they are regularly handled. Depilation is effected as soon as the hair can be easily pulled out, after which the hides are soaked in water for a few hours. Water-stripes and dots are produced by soaking the hides too long in running water, and allowing them to remain stationary. After fleshing and soaking for twenty-four hours the hides are smoothed and placed in the bate for one to three days, according to their thickness and the state of the weather. They are handled three times every day they remain in the bate. If the England wheel shown in Fig. 112 is employed the bating can be accomplished in from eight to ten hours. Special attention should be paid to this process, as soft leather can only be produced by proper bating, while too much bating is injurious, as it destroys the skin fibres and the grain. After taking the hides from the bate and rinsing in fresh water they are again smoothed, and after soaking for several hours thoroughly worked upon the flesh side with a dull fleshing knife. They are then ready for tanning.

Salted hides of cows and oxen are soaked three days, special attention being paid to remove all the salt before placing the hides in the lime pit. Dried hides after thorough soaking and bringing them back to their original shape by stretching, are

treated in the same manner as green hides. By using the hide mill described in Chapter XIV., much labor in stretching and smoothing may be saved, and for inferior hides, slicking also.

The handling vats should be sufficiently large to allow of the convenient handling of the hides.

It is generally preferred to place the leather in old liquor for one or two days, according to the quality of the liquor in the vat. The leathers are taken out and replaced and treated in the same manner as above, after ladling out the old tan and adding one-third bushel of fresh tan. According to the state of the weather the power of the tan will be exhausted in four to eight days, it then becoming necessary to freshen the vats. After doing this twice or three times more the leathers are placed in the lay-aways, where they remain for about the same period as for sole leather, a longer period being as a general rule only required for stout harness and vache-leather, but it is absolutely necessary for belt leather.

In order to see how far tanning has proceeded it is advisable to split the leathers after the second layer. The cut of a thoroughly tanned hide will be uniformly brown, while a pale yellow or white coloring is a proof of insufficient tanning.

After splitting the hides into sides and numbering the two halves with the same number, the completely tanned leather is rinsed in old ooze and smoothed with a dull fleshing knife upon the beam. Where all three kinds of leather are made, the best hides are used for harness leather, the strongest for belt leather, and the poorest for vache-leather.

The harness leather is gone over with a fine-edged knife and then greased upon the flesh side with a mixture of linseed oil and tallow, and hung up to dry. Vache-leather is also greased but only slightly upon the grain side and then dried.

Preparation of Vache-Leather.

The dried hides are soaked in sufficient well-water to cover them in a vat, handled after an hour, then replaced and allowed to soak over night. The next day they are placed upon a wooden table, and after tucking in the hoofs rolled up grain side

in from the head to the tail, so that every half hide forms a roll. The rolls are tied together with strong twine or leather straps so that they will not become unrolled in the succeeding beating with fluted wooden mallets, which is continued until the hide feels soft to the touch.

To soften them completely they are boarded, after beating, upon the grain side with a coarse graining board. After working ten or twelve hides in this manner a thin shaving is taken from the flesh side. The best plan is to have two workmen perform the above operations and also the succeeding ones. In tanneries provided with a fulling mill a higher degree of suppleness can be imparted to vache-hides by fulling than is possible by beating and boarding with the graining board.

One-half of the hide is then placed upon a somewhat inclined table of wood, slate, or zinc, as shown in Fig. 137, as long as the hide and as wide as one-half the hide, and scrubbed with brushes constantly dipped in water until the flesh side acquires a mushy condition, which can be recognized by the impressions made by passing the fingers over the hide remaining visible. It is then turned over and, after placing the back part in a straight line with the edge of the table and passing the hand over the hide so that it sticks to the table, the grain side is treated in the same manner.

The slicker is then driven first along the back to prevent the wrinkles which are formed from sticking, and then in the direction from the back to the fore-hoof. After removing the wrinkles, which is absolutely necessary, more force may be used for the removal of tan depressions.

As soon as one half of the hide is slickered it is immediately hung up in the drying loft. If this is higher than the length of the hide, the latter is nailed through the hind hoof and root of the tail to short strong sticks, or incisions are made in these places, and after passing through the sticks the latter are placed between two poles.

If the loft is not very high, the back part of the hide is nailed to straight strong poles, which after tying the front and hind hoofs with twine in such a manner that they cannot hang down and form wrinkles, are placed in the pole-rack.

After the hides are partly dry, they are placed separately upon the table and, after wetting slightly such parts as have become too dry, one hide is placed above the other and the pile repacked. The hides moistened first are then replaced upon the table and after fitting the back exactly to the edge of the table it is fastened with a few wooden clamps, the impressions of which are removed later on.

To remove all tan depressions and to give the leather a beautiful appearance and firm touch, the use of a roller is of great advantage, especially as it facilitates the currying and prevents the grain from being injured by constant working.

The tan impressions, etc., are then entirely removed, and after rubbing with a moist woollen rag the sides are stamped and hung up.

Before the hides become entirely dry the halves are fitted together according to the numbers and placed grain side upon grain side and hide upon hide until a pile is formed, which is covered with planks somewhat loaded.

After remaining here for twelve hours they are hung across poles and gradually dried. Each hide is then rolled up separately and about six placed in one bundle, which is secured with twine.

It is scarcely necessary for us to say that scrupulous cleanliness must prevail during all these operations. By strictly following the directions given, an article fulfilling all demands will be the result, and one which is not only equal to the best *Frankfurt* vache-leather, but in most cases surpasses it as regards beauty and quality.

After the harness leather has passed through all the above operations it is sorted into brown and black. The first acquires lustre by means of a glassing machine, or is sold without it. The black leather after grounding with decoction of logwood is blacked with iron black and, when nearly dry, passed through the press.

The best qualities of light hides from Buenos Ayres, Montevideo, and Texas may also be used for vache-leather. The lime used for hides intended for vache-leather and inside sole leather is sometimes mixed with red arsenic. This has a better effect

upon the hide, also softening hard places found in these hides which are always difficult to soften. In using this mixture the hides require more frequent handling than in the ordinary liming process, and should be depilated as soon as possible. As the hides are not raised by the mixture it may also be recommended to subject them to the ordinary liming for a day after taking them from the arsenic and lime liquor. This method of liming can also be advantageously employed in preparing green hides and kips for upper leather, but the after-liming must be continued for a correspondingly longer time.

Machine Belt Leather greased with Tallow.

By greasing with tallow this leather acquires the desirable property of not becoming hard even if the belt cut from it has to pass, as is frequently the case, through water. This leather is tanned in the same manner as has been described for sole leather, complete tanning being the principal requisite.

After dividing the hides into sides and rinsing off the tan, the sides are scoured either by hand or machinery so as to prepare them for the reception of the tallow. The sides are then treated differently from the leather that is to be used for uppers of boots and shoes, in that it is not dampened and tempered, as has been described for heavy upper leather. But the sides after being scoured are dried in heat; in summer by spreading them out and exposing them to the direct rays of the sun, and in winter in a room having a temperature of at least 110° F.

Pure tallow, best ox tallow, is melted in the meanwhile in a portable boiler, a temperature of 167° F. being the best for the purpose. This temperature should be kept up after the tallow is melted, which can be effected by keeping the boiler over a small coal-fire or, still better, by placing it in another boiler with hot water, which is kept hot over a fire while the work is going on.

One of the heated sides is then placed upon the table and the fluid tallow applied with a brush. The hide should be so thoroughly saturated with the tallow as to be entirely permeated with it, and the tallow applied to the flesh side become visible

upon the grain side. Should the tallow congeal upon the surface before permeating, it is allowed to soak in by placing the hide in the sun or near a warm stove, but if the hide is already thoroughly permeated, the excess of tallow must be removed.

Currying the Tallowed Leather.

The sides having lost their good appearance and become dark by greasing with tallow, are soaked in water for twenty-four hours and then placed upon the beam, and the tallow still adhering to the flesh side removed with a blunt knife. After placing them again in water, each side is taken out separately, and after spreading it upon the table and covering with a layer of spent tan one-half inch thick, it is rolled up, and the roll, after securing it with twine, beaten with a mallet, until the leather has again acquired a light color and its original suppleness.

After rinsing off the tan the hides are again beaten, with frequent dipping in water in case they should feel too dry. They are next smoothed in the same manner as for the ordinary machine belt leather.

It is recommended to have two men to do the work, it being too fatiguing for one.

The manufacture of this variety of leather, though very laborious, repays doubly the work expended upon it, principally by the increased weight the leather acquires by the absorption of tallow.

CHAPTER XXXII.

MOROCCO LEATHERS.

Section I. Tanning and Finishing Imitation of French Kid, Brushed Kid, Straight Grained Goat, Pebbled Goat, and Oiled Goat.

By Morocco leather we understand that soft, pliable material so largely employed in the manufacture of the uppers of ladies' and children's shoes, and gentlemen's low cut shoes, and which also finds various secondary employments, such as bindings for books, linings for travelling bags, toilet cases, pocket books, etc.

The finer grades of Morocco leather are produced from goat-skins, but an inferior quality is obtained from sheep-skins, and split calf-skins.

The usual commercial classification of Morocco leather, produced in this country, is:—

Imitation of French kid.	Pebbles.
Brushed kid.	Straight-grained goat.
Oiled goat.	Caracal, or straight calf.
Pony-glazed kid.	Siamang.
Glazed kid.	

The goat-skins employed in this country for the manufacture of Morocco leather, are classed as follows, and rank according to their position in the list:—

Curacoa.	Russians.
South Americans.	Capes.
Madras.	Arabians.
Tampico.	Macedonians.
Patnas.	Angoras.
Mochas.	Albanians.
Kassan.	Magadores.

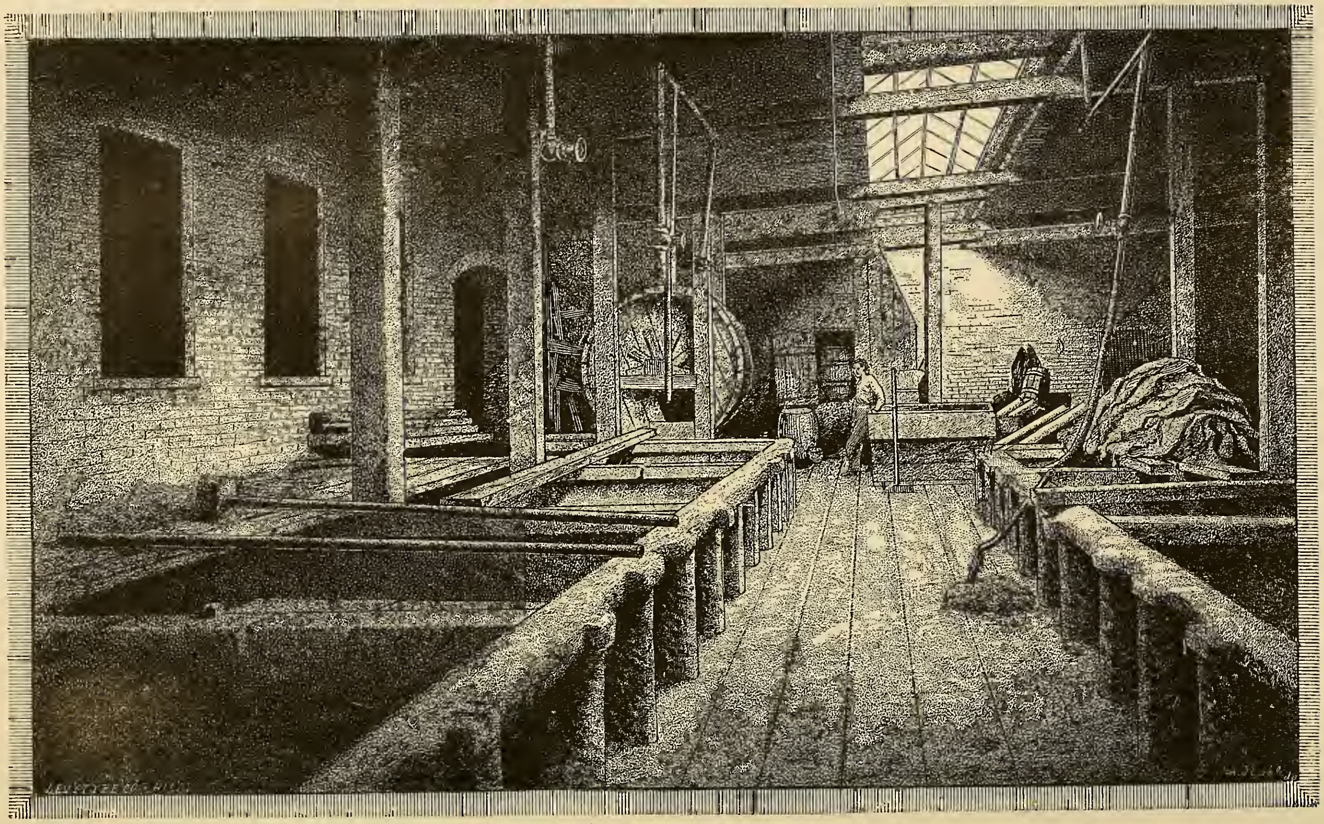


Fig. 234. Lime-vats in a Morocco Tannery. Page 525.

Glove-calf and glove-sheep are also sub-names for Morocco leather, and are used principally for toppings for button, laced, and congress boots for ladies' and gentlemen's wear. Sometimes shoes for elderly gentlemen and ladies have the uppers made entirely of these leathers, which are desirable for this purpose, being soft and comfortable to the feet.

When glove-calf and glove sheep are kept dry they continue soft, but when frequently wetted the tannin is drawn from the leather, which renders it hard and liable to crack.

A large portion of the skins used in this country for the manufacture of glove-calf and glove-sheep are produced in the United States; but South America and Russia also send us large quantities. The imitation French kid made in this country will remain pliable under continued wetting much longer than the genuine French kid.

The tanning material usually employed for all the stock which has been mentioned is sumach, which is used in the proportion of about one-half Sicily or imported, and one-half Virginia or native.

The process of preparing the skins for the reception of the tannin is about the same for all the stock that has been named.

Preparing the Skins.

When the dry skins are removed from the bales, they are placed in the "soaks," which are vats containing clear cold water, and remain for from three to five days, the period of course depending upon the condition of the skins, the hardest requiring a longer soaking than those that are softer.

From the "soaks" the skins are removed either with hooks or tongs, and placed, usually 150 to 200 at one time, in the "pin-mill," which softening contrivance has been described on page 250, and when sufficiently softened the skins are next placed in the "limes."

Fig. 234 shows a view of the lime-vats, in a Morocco tannery, and over one of the pits is shown a pile of skins which have been removed therefrom and placed upon planks to drain, while in the background is shown the "wash wheel." Above each lime-vat there is a small blackboard upon which are marked in

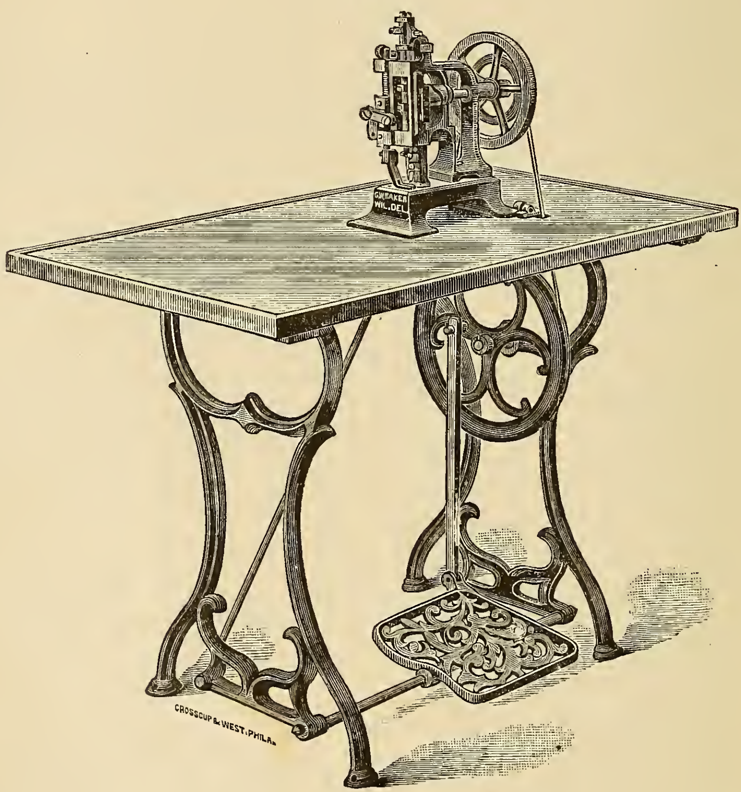
chalk the number and kind of skins in each vat and the date on which they were put in.

In large Morocco tanneries usually 1350 South American goat-skins are limed at the same time, and about 600 glove-calf, and 800 glove-sheep are placed in separate vats at once.

The goat-skins remain in the "limes" about 14 days, glove-calf 12 days, and glove-sheep 8 days.

They then go to the unhairing beams and are unhaired by hand, and one man will "unhair, flesh, and slick" about eighty skins per day.

Fig. 235.



After being unhaired the skins are placed in a mill and thoroughly washed to free them from adhering lime, and are

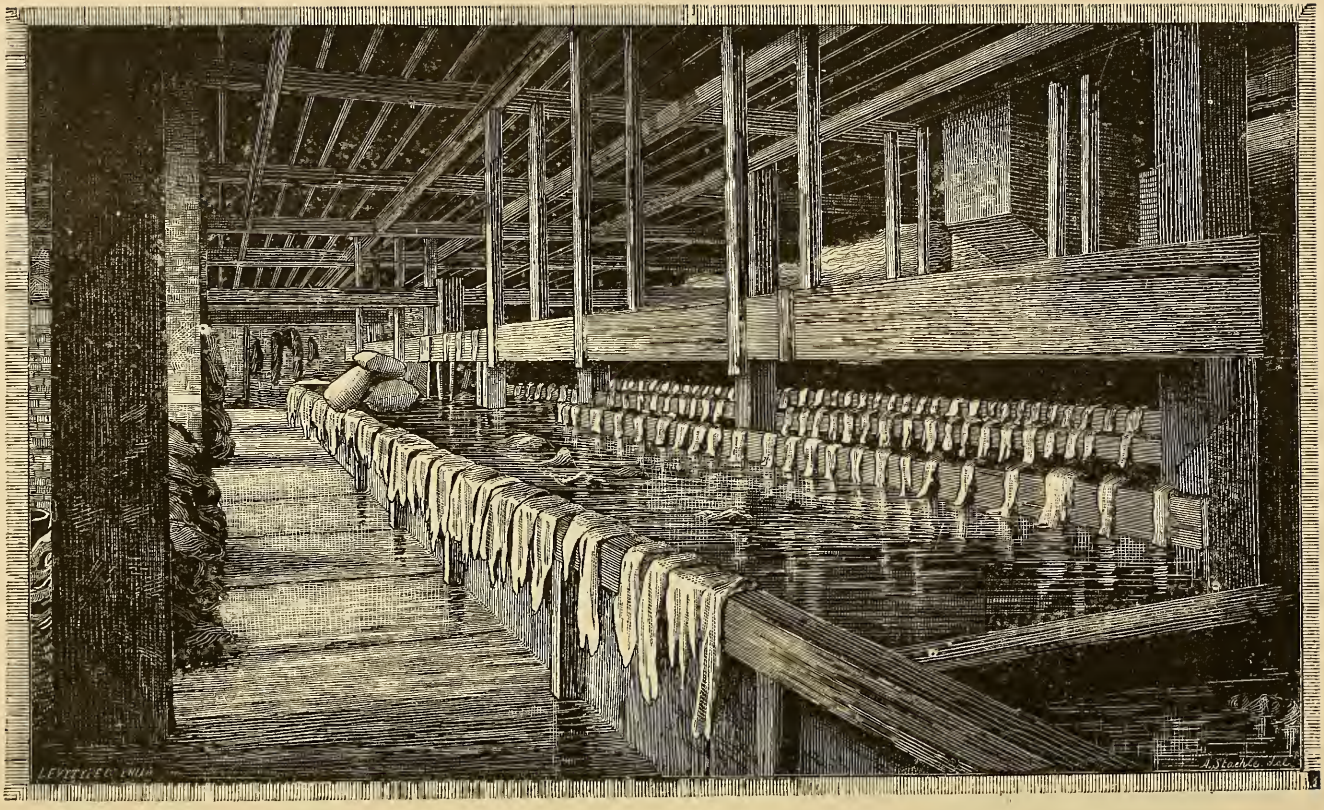


Fig. 236. Tan-tubs in a Morocco Factory. Page 527.

next placed in the slightly heated bate of dog or pigeon manure, in which they remain over night.

Upon removal from the bate the skins are "slated," which is the removal of the fine hair remaining upon the skins after the unhairing operation. The "slater" is a tool closely resembling a "slicker;" but the edge of the "slater" is ground sharp.

The skins are now passed into the bran drench, which is composed of bran and water, slightly heated, and in this they remain over night, and are then in condition to be sewed together.

The sewing is usually performed on heavy chain stitch sewing machines, operated by women, who are paid at the rate of about ten cents per dozen skins.

The usual form of machine employed is represented in Fig. 235, and it is made to sew either way, being one thus adapted to all classes of sewers; it is strong, and thoroughly fitted for the hard and dirty work to which it is subjected, and may be run by foot or steam power.

The skins are sewed in the form of a bag, the only opening left being one at the end of the hind shanks, which is to allow the spigots on the sides of the tan-tubs to enter and thus force the tannin into the interior of the bag.

Tanning.

The skins are sewed grain side out, and when placed in the tannin liquor the shanks are placed over the spigots, the skins tied to them with twine, and the liquor forced into the skins with a gentle pressure by means of a pump.

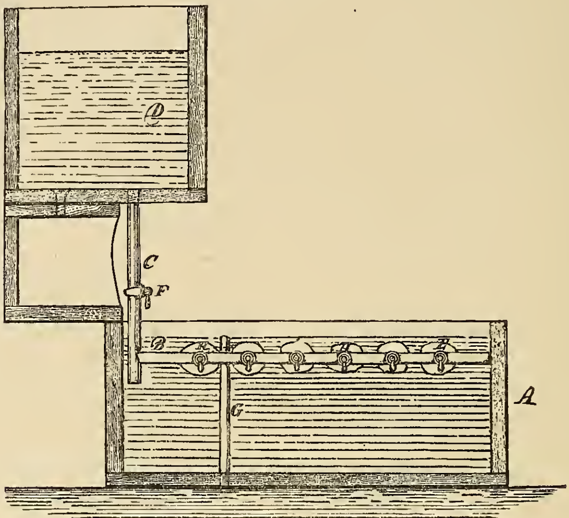
The vats are filled with sumach liquor in which the skins are submerged, and three hours is usually sufficient time to complete the tanning. When it is desired to hasten the tanning process, the pressure from the pump is increased.

Fig. 236 shows a view of the tan-tubs in a Morocco factory, and Figs. 237 and 238 show the manner in which the skins are attached to the spigots and a method by which the skin-bags are filled with the sumach liquor.

The invention shown in Figs. 237 and 228 is that of John G. Baker, of Wilmington, Del., and it consists of a vat or tank with a feeding-pipe leading into a horizontal pipe at one end of the

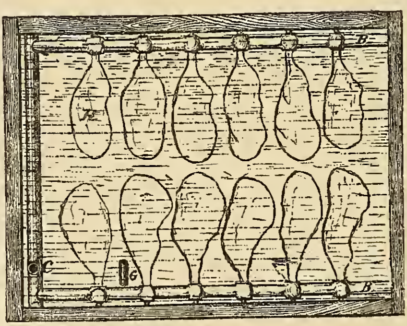
tan-tub, connecting at each end with another pipe or tube provided with cocks or spigots, set at regular intervals, to the noz-

Fig. 237.



zles of which, facing the centre of the tan-tubs, are fastened by tying, the skin-bags to be tanned, so that the liquor will flow

Fig. 238.



into and suspend them in the liquor contained in the tub while under a pressure in combination with the tan-tub and its stand-pipe.

By this invention it is sought to provide an improved mode of filling and pressing sheep and goat skins while being tanned without their coming in contact with the sides or bottom of the tub or with each other.

It is a well-known fact that if the skin-bags press against each other or against the tub, they will be but imperfectly tanned, and also that where skins are suspended by their necks in a vertical position their weight when distended causes them to break or tear away from the nozzle.

In Figs. 237 and 238, *A* is the tan-tub; *B* is the tube attached to the walls of the tub, and connecting with the feed-pipe; *C* is the feed or supply-pipe for filling the bags from the vat or tank; *D* is the vat or tank; *E* is one of the cocks of the tub, to the nozzle of which the skins are fastened; and *G* is the stand-pipe or overflow-pipe to keep the liquor at a uniform height.

The reservoir, feed-pipe, and tubes with their cocks are not a new idea, as they are described in the invention of Dr. Alexander Turnbull, of England, who obtained a patent in this country September 26, 1844, and also in the patent issued to Dudley and Brooks of Portland, Me., dated October 23, 1834. But the differences between both of the plans which have been named and the present one are plainly obvious, as the skins in both of those patents come in contact with each other, or with the floor or walls of the tan-tub.

In Turnbull's plan the skins are laid upon the floor of the vat and partly submerged, and require turning, and in the other patent the skins are suspended by their necks, and are but partly submerged, and so hung as to come in contact with each other, while in the present instance they are so arranged and hung to the tubes or pipes, as to render contact almost impossible, and are buoyed up by the liquor. Warner's apparatus for tanning goat and sheep skins is shown in Figs. 244 to 249, and G. C. Walters's filling cup in Figs. 250 to 253, and Halsey's combined vat and wheel in Figs. 255 and 256.

The skins are taken from the tan-tubs and when full of liquor are piled one upon the other in open vats provided for the purpose at each end of the tanning-tubs, and thus the liquor is

gradually pressed out and passes into a receiver, from whence it is pumped back into the tanning vats.

After the liquor has been squeezed out, the bags are removed from the open vats and one end of the thread cut with an ordinary shoe knife, thus allowing the thread to be pulled out at one operation.

The skins next go into the England wheel vat, which has been shown in Fig. 112, and are "wheeled" in sumach liquor of about 20° strength, which is the same as in the tanning vats.

Striking Out and Drying.

The skins are next "struck out" on mahogany tables, which are so shaped as to slant from the workman at an angle of about 45°.

A steel "slicker" is used for this operation, and an average workman will "strike out" about 200 skins in ten hours.

The object of this operation is to increase the size of the skins, remove the adhering "fleshings," tanning liquors, and water, and render the skins smooth and even, and this is accomplished in some tanneries by the employment of machinery, shown in Figs. 257 to 261.

The skins after being "struck out" are hung up in the drying lofts and dried by the atmosphere; the time required for this depending upon the condition of the weather.

Fig. 239 shows the drying loft in a Morocco factory, the skins being hung on hooks which are shown on the racks placed at a convenient height from the floor. When sufficiently dry the skins are removed from the hooks and carried to a room on the same floor as the loft, and there assorted according to the kind of leather into which they are to be finished. This important point having been decided upon, the skins are removed to the cellar and wetted down in soap-water, and while wet the skins are carried to a currier's beam and shaved with a currier's knife on the flesh side, so as to make them of a uniform thickness, and also for the purpose of having them receive a better finish.

From this point all the skins pass to the finishing-room, and as each kind of Morocco leather requires a different treatment,

Fig. 239. Drying-loft in a Morocco Factory. Page 530.

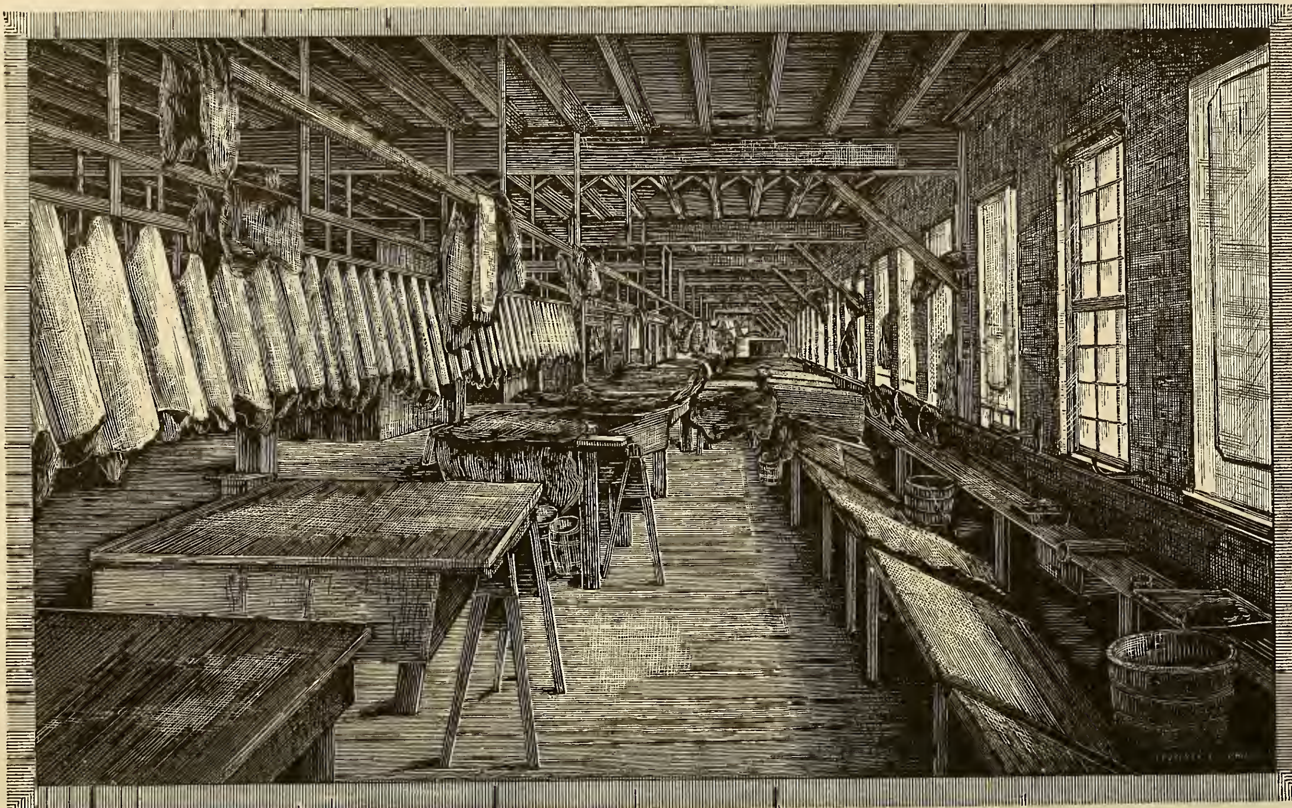


Fig. 240. Finishing-room in a Morocco Factory. Page 531.

we will now describe each separate mode of finishing the various kinds.

Finishing Imitation of French Kid.

This class of leather has taken a high rank in our country, and it is now generally conceded to be much superior to the genuine French kid for wear.

The skins, after being treated as above described, are carried to the coloring table and colored on the grain side, with an iron and nutgall-black having a logwood body which gives a clear and bright black, and after being blacked the skins are hung up in the loft. The skins, after the first blacking has dried, next pass into the finishing-room, and the second application of black is made, which is similar to the first, with the exception of the nutgalls, which are omitted; bichromate of potash is sometimes used in this black, but in small quantities. After this second application of color, the skins are hung upon racks in the finishing-room, and left until the color sets or dries, the blackened side being turned inward, as shown in Fig. 240, which shows a perspective view of the blacking tables and an interior perspective view of the finishing room.

After being removed from the hooks they are next moistened with a solution of milk and water, and are then ready to be glazed, which operation is performed by machines of various constructions, and which have been heretofore explained in Chapter XXVI. Knox's machine, shown in Fig. 211, is much used for glazing this variety of Morocco.

The skins are next softened by hand with a board and scraper, or, as it is termed, a "softening slicker."

They are then oiled with the best sperm oil, which is applied with a rolled-up flannel cloth.

The skins are glazed two or three times as the case requires, the oil is applied twice, and after the last application the imitation French kid is ready for market.

In selecting skins for the production of this class of leather, their weight is regulated by the demands of the trade, at times being light, and at others heavy. The skins are also selected for their cutting qualities, those which are free from blemishes

or breaks being, of course, more valuable than those that are scratched.

Finishing Brushed Kid.

The finishers take the South American goat-skins from the shaving-beams and "put them out," and each man will put out and black five dozen per day, and after being thus treated they are hung in the loft and dried by the atmosphere.

The skins are blacked and seasoned with the same preparation of bullock's blood, iron, and vinegar black which is applied with a piece of flannel cloth made into a roll. They are then wet over with gum-water and brushed with a very soft brush, called a "kid-brush." After being hung in the loft and dried, the skins are next "back-boarded," then glassed, and next rolled by a machine having a steel roller. The Knox machine shown in Fig. 211 is commonly used for glassing and rolling.

The finisher takes the skins from the rolling machine and scrapes them with a steel slicker in order to loosen up the flesh, after which the grain side is oiled with the best sperm oil, which is applied by means of a roll of flannel cloth. The brushed kid is now completed and ready for market.

Finishing Straight-Grained Goat.

The first step after shaving in finishing this variety of Morocco is the "putting-out," which is performed by working over both sides of the skin with a steel slicker. This portion of the work is sometimes accomplished by machinery, such as is shown in Figs. 257 to 261. When done by hand about five dozen large skins or nine dozen small ones are put out by a skillful workman in one day. The skins thus treated in the morning are placed in the loft, and in the afternoon they are "put out the second way," which consists in smoothing the grain side. They are drawn out and the stretch removed in the first operation.

When the skins are placed in the loft they are spread out separately on the floor, as shown in Fig. 241, and are not allowed to become too dry, and in the afternoon when they are "set out the second time," no water issues from them. After being set

Fig. 241. View of Drying-loft in a Morocco Factory—showing the Skins spread out. Page 532.

out the second time they are returned to the loft and placed on trestles, which are about two feet six inches high, and they remain in this loft until dry, the period of course depending upon the state of the weather.

The day's work of each man is kept separate from that of the others, and each workman hangs up his own day's work of skins, one on each hook, and so placed that none of them touch each other.

When dry the skins are packed in piles, those that are intended to be stained on the flesh side being separated from those that are to be pebbled.

They are next carried to the finishing-room and the rough part of the grained side is smoothed off with a piece of fine emery paper, rolled so as to expose the length of the paper to the skin.

This portion of the work is sometimes accomplished by machinery; a revolving emery stone, such as is used in the manufacture of kid gloves, being employed, the dust being blown from the stone by a suitable fan.

The skins are next seasoned, which is accomplished by coating them with a preparation of bullock's blood, logwood boiled, cow's milk, water, and a small quantity of vinegar black, made by treating iron with vinegar, one gill of the latter preparation being used for a bucketful of "seasoning," which quantity will season above five dozen straight-grained goat-skins. After the seasoning has dried they are regularly blacked and hung up in the finishing-room, as shown in Fig. 240, and after remaining on the hooks for about one and one-half hours, or until the dampness leaves the skins, they are rolled by machinery; the machine shown in Fig. 211 being largely used for this purpose. After being rolled the skins are again hung up in the finishing-room and remain over night, and in the morning they are glazed on a machine having a glass roller, the one shown in Figs. 204 and 209 being much used for this purpose.

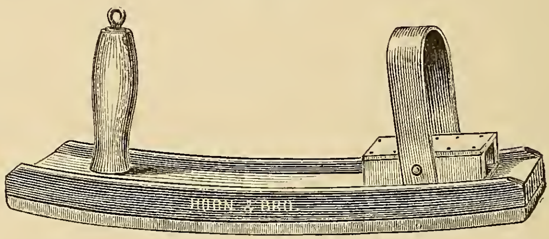
The number of skins rolled or glazed is from 30 to 50 dozen per day for each machine, depending upon the speed at which the machine is driven and also upon the size of the skins and quality of the work. Some are glazed lighter than others, in

order to give a medium gloss, but when a high gloss is desired, extra pressure is applied. Fig. 242 shows a perspective view of the portion of the finishing-room in which the skins are being rolled and glazed.

After the skins are glazed they are wetted in cold water by passing them through a large tub holding about 50 gallons, and the workman in accomplishing this takes two of them and places them grain to grain, and grasping hold of the butt of the skins draws them slowly towards him.

They are next grained, which may be performed either by hand or machinery; if done by hand, a graining board similar to that shown in Fig. 242 is employed.

Fig. 243.



These graining boards are made with a cork face, and in using them the arm passes through the strap and the hands grasp the handle.

The object in using this tool is to raise the grain and to make the straight-grained goat-skins more durable, and also has the effect of rendering them more pliable as well as tougher.

The skins are again hung in the loft usually above the finishing-room and dried by the atmosphere, which requires from 24 to 48 hours, according to the state of the weather. After this drying they are again grained, which has the tendency to raise the figure and further mellowing them. All the graining is done on the grain side; but after the second graining they are "back-boarded" on the flesh side, which has a tendency to make the figure more uniform as well as to still further soften the skins.

An application of best sperm oil to the grain side of the skins

Fig. 242. Rolling and Glazing Morocco. Page 534.

completes the finishing of straight-grained goat, and as the oil is immediately absorbed by the pores, the skins are at once ready for market.

From the time that they enter the finishing shop to the time that the straight-grained goat is ready for market, the period is about seven to ten days, being shortest in good drying weather and longest when the condition of the atmosphere is not favorable. There is also a grade of Morocco leather known as "caracal," which is straight-grained calf, and its peculiarities are pliability, toughness, gloss, and superior finish. This leather has a fancy finish, and its introduction into the trade has been but to a limited extent.

Finishing Pebble-Grain Goat.

The difference in finishing pebble-grain goat from that of straight-grained is that the first named is "cut" four ways in the process of hand-finishing, in the softening, and in the "springing up;" but in "back-boarding" it is cut two ways only. The skins are pebbled on the same machine, but not with the same roller that is used for straight graining.

Finishing Oil Goat.

In finishing "oil goat," after the skins have been "put out the second way" and blacked, they are then stuffed with dubbing on the flesh side. The dubbing is composed of one-half oil and one-half tallow when used during the winter time; but in the summer more tallow than oil is used. They are then hung up to dry, after which they are grained three ways and then treated to a coat of dubbing on the grain side, after which they are flattened down on the grain side with a dull slicker, and after being treated with a coat of fine sperm oil which completes the finishing, the oil goat-skins are then measured and marked ready for the trade.

This class of Morocco leather is more water-proof than the other grades, and is used for ladies' heavy wear, and sometimes boys' boots are made from it.

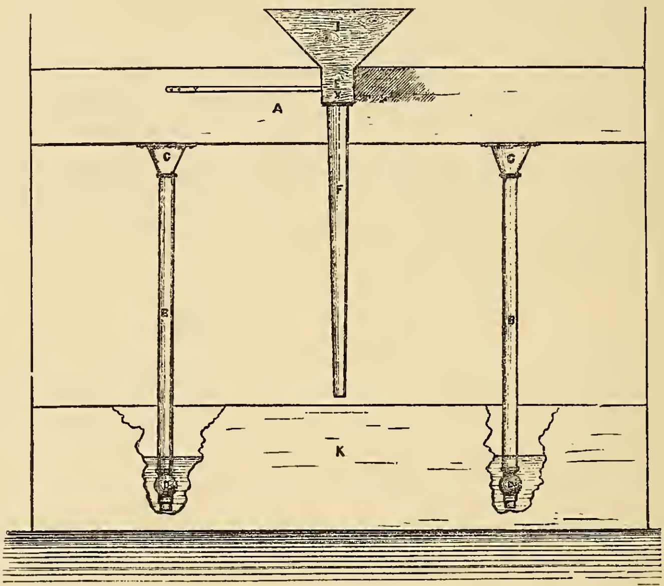
The heaviest skins are used for this kind of leather, and the kinds commonly employed are Tampico, Capes, and Patnas.

Section II. Tanning Apparatuses for Goat and Sheep-Skins.

Warner's Apparatus.

The apparatus shown in Figs. 244 to 249 for tanning goat and sheep-skins is known as Warner's Apparatus, and was invented in 1870 by William Y. Warner and James Crooks, of Wilmington, Del., and the fittings for it may be obtained from G. W. Baker, Wilmington, Del.

Fig. 244.



The first part consists in the combination of a feeding-trough for containing tanning-liquor, filling-hose with funnel-connections, and valved ends, a gauge-box with slides for feeding tanning-materials into the skins or hides, operated by means of a rod and spring, having attached to it a tapering pipe, which receives the tanning-material in its passage into the skins, and a smaller pipe, which leads the water from the liquor-feeding trough into this tapering pipe.

The object is to obviate the necessity of using a funnel and dipper in the filling of the skins with tanning-material and

Fig. 245.

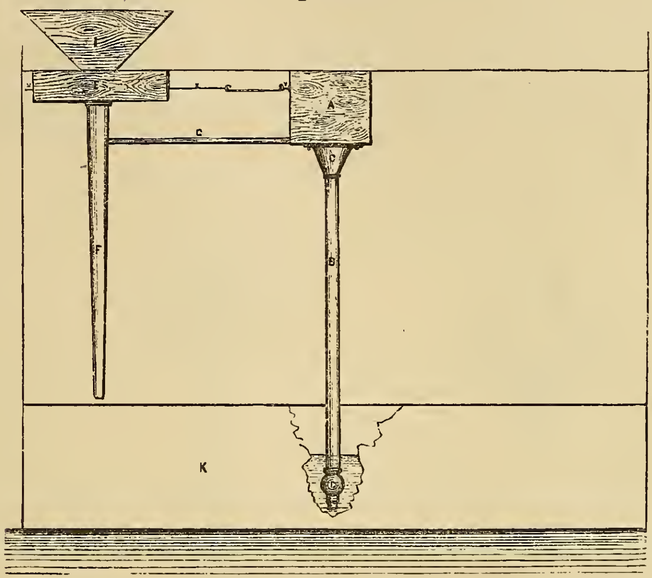
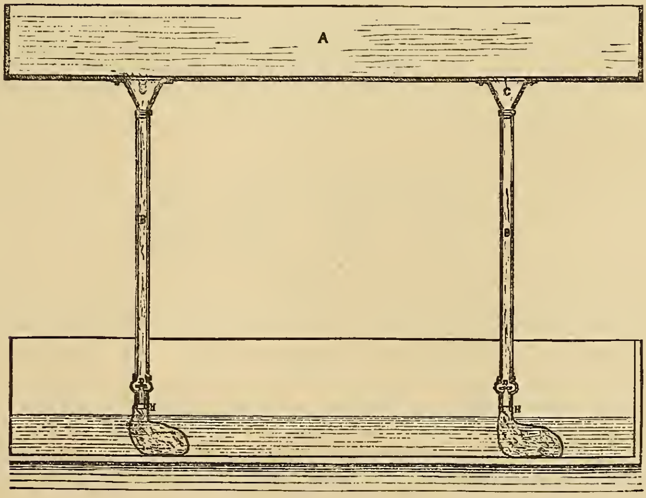


Fig. 246.



liquor, and to enable the workman to fill both at the same time, without waste.

The second part consists of a valve, which is applied to the mouth or opening of the skin which retains the liquor, when distended or filled.

The object of this is to dispense with the troublesome process of tying and untying the mouths or necks of the skins, in filling, and, at the same time, retaining the tanning-material.

Fig. 247.

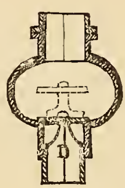


Fig. 248.

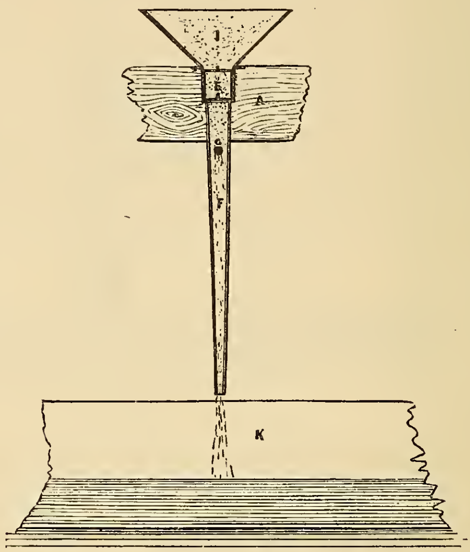


Fig. 249.

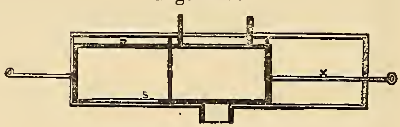


Figure 244 is a front view of a machine embodying Warner and Crooks's invention; Fig. 245 an end view; Fig. 246 a longitudinal section; Fig. 247, a section of the valve in the hose; Fig. 248, a vertical transverse section, showing the end of the machine, which is at the right hand in Fig. 244; and Fig. 249 is a section through the centre of the gauge-box and its slides.

A is the feeding-trough, which is attached to the joists of the floor above the workman's head.

B is the filling-hose, with funnel-head C and valve D attached.

E is the gauge-box with its slides S S, operated by means of the rod X and spring Y, for regulating the quantity of tanning-material used.

F is the tapering pipe, through which the material passes into the skins.

G is the pipe which carries the tanning-liquor from the feeding-trough A into the tapering pipe F, for the purpose of forcing the tanning-material into the skins or hides.

H is the valve, which is fastened to the mouth of each skin or hide.

I is the bin for holding the sumach, or tanning-material.

K is the tan-tub, in which the skins are filled, and from which the liquor is pumped back into the feeding trough A, when required.

The skins to be tanned, after sewing, have the valve H attached. The liquor is pumped from the tan-tub K into the trough A, which runs the whole length of the tan-tub.

The sumach, or other tanning-material, is fed from the bin I through the gauge-box E.

In filling, the skins or hides are taken to the tapering pipe F, the end of which is inserted in the mouth or neck of the skin, forcing open the valve H. The slides S S, in the gauge-box E, are pulled forward, the tanning-material descends, the valves S S closing instantly, while the liquor which is constantly running through the small pipe G, washes all into the skin, which is then removed, and passed to the workman stationed in charge of the filling-hose B, who brings the mouth of the skin under the valved end of the hose, which forces up the valve D, and the skin is entirely filled. Here, the operation is complete, and the skins or hides remain in the tan-tub until it becomes necessary to refill them.

Walters's Filling-Cup for Morocco Manufacturers.

The filling-cup for Morocco manufacturers shown in Figs. 250 to 253 was invented in 1881 by George C. Walters of

Philadelphia, Pa., and the invention consists in the novel construction and arrangement of a valved cup having a valve-seat above the valve, an outwardly projecting extension, to which an extension on the rubber or other flexible valve is secured by screws driven outwardly from below at angles of about seventy degrees to the plane of the valve, and an encircling flange at the bottom of the cup, whereby the leg of the skin may be securely attached to the cup. The skins are first sewed in the ordinary manner at the edges, as has already been described, and the valved cup applied to an opening in the end of one of the legs of the skin by tying the cup therein.

The old form of valve consisted of a circular cup with an outward projection in its inner edge or opening, around which the skin was tied. The valve rested on the outer surface of the inner edge of the cup and extended to the extreme edge. This construction permitted the valve to be dragged open when it came in contact with anything while handling the filled skins, and permitted the liquor to escape, which accident resulted in only partially tanning the skins. In the old form the projection to which the valve was attached was on the inner side of the cup. This construction lessened the opening in the cup, caused clogging, and produced an overflow of the filling material, which could only be replaced by guess-work. The screws were also passed through the valve at right angles to its horizontal plane, whereby it did not bear with sufficient force on the edge of the cup when the skins were partially emptied, and from that cause the liquor would escape.

By Walters's construction it is claimed that these objections are removed, as, in the first place, the valve is seated within the cup and cannot be displaced by accident in handling the filled skins; and, secondly, the projections on the cup and the valve in connection with the inclined screws, hold the valve more firmly, and the interior periphery of the cup is not obstructed, and is therefore not liable to clog, either during the filling or the emptying of the skin. A funnel is inserted into the cup and secured during the filling operation, and the sumach is placed therein, and a stream or drip of water from above falls thereon and produces a tanning-mixture of about the consistency

of cream. After filling, the funnel is withdrawn and the valve closed. The skins may then be piled for storage.

Figure 250 is a representation of a perspective view of Walters's device. Fig. 251 is a bottom view. Fig. 252 is a sectional view, and Fig. 253 is a vertical section as applied.

Fig. 250.

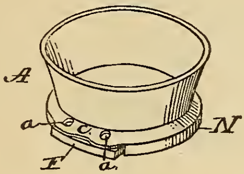


Fig. 251.

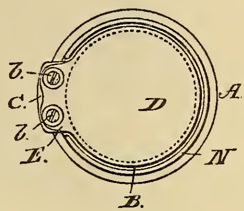


Fig. 252.

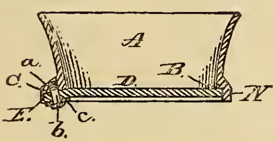
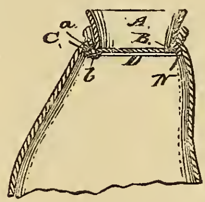


Fig. 253.



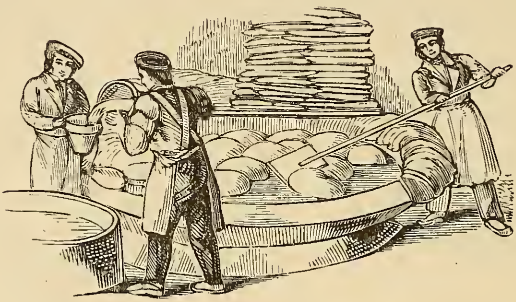
A designates the cup, of metal or other suitable material, having the valve-seat *B* at its lower edge, as shown. *N* designates a flanged projection entirely surrounding the cup, whereby the skin may be securely attached to the cup, and *C* the outwardly-projecting extension, having the outwardly-inclined threaded holes *a a* for the reception of the screws *b*, which secure the valve *D* in place in its seat. The valve *D* is preferably of rubber, and has an extension, *E*, corresponding in shape to the extension *C*, to which it is secured by screws *b*, washers *c* being interposed between the valve and the screw-heads.

Hand Method of Tanning Morocco.

In many of the small Morocco tanneries the skin bags are filled with sumach liquor, as shown in Fig. 254, and after being inflated with the breath are tied with strings and made to float

in sumach liquor by constantly agitating them so as to facilitate the action of the tanning material.

Fig. 254.



The process is repeated until the skins are tanned, when the bags are removed from the tub and piled upon one another and left to press and drain. After this the skins are unstitched and rinsed, then scraped lightly on the beam and hung in the drying loft.

Tanning Morocco in a Combined Wheel and Vat.

The apparatus shown in Figs. 255 and 256 was invented in 1883 by D. Halsey, Jr., of Newark, N. J.

In the use of sumach in tanning goat-skins and Morocco, as has been explained in this chapter, the skins are commonly sewed up and the liquor and ground sumach placed inside of them, and are then placed in contact with the same substances in a tan-vat. By the use of this wheel the sumach is kept suspended in the liquor in the desired manner, and the skins are turned over and over in contact therewith, so as to produce satisfactory results, both in regard to the time consumed and the quality of the work performed. The sumach, however, settles to the bottom of the vat when the motion of the wheel ceases, and to remove it conveniently the vat is constructed above ground and provided with the door *M*, shown in Fig. 255, at the bottom for the convenient removal and rinsing out of the sediment. Fig. 255 is a transverse section of this wheel and vat on the line x x in Fig. 256, the latter being a plan.

A is the vat; *B* the wheel; *C* a gear of ring form secured to the periphery of the wheel at one edge; *D* a door for the

Fig. 255.

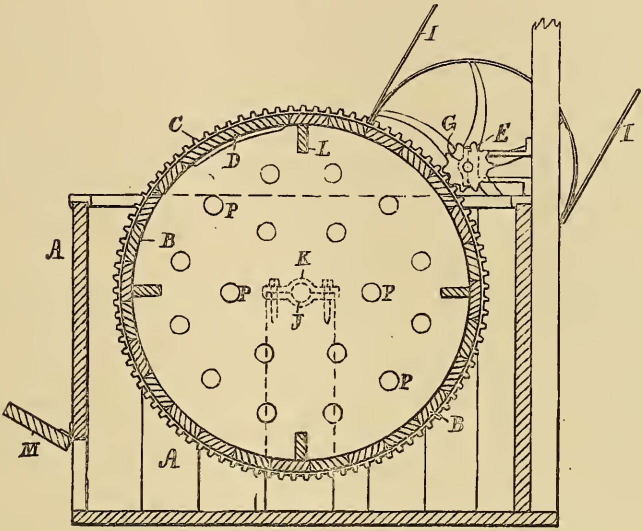
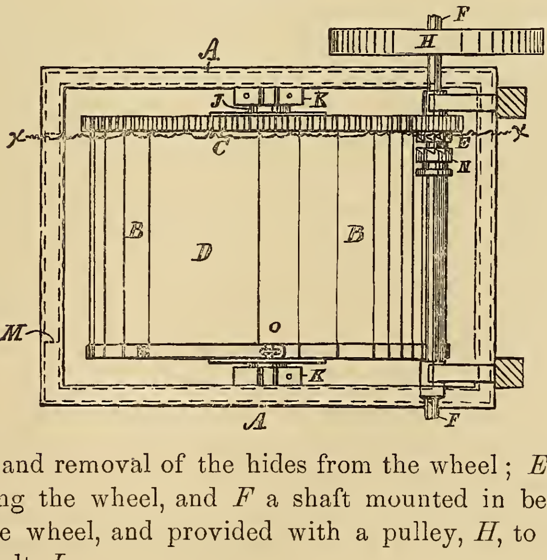


Fig. 256.



insertion and removal of the hides from the wheel; *E* a pinion for driving the wheel, and *F* a shaft mounted in bearings *G* above the wheel, and provided with a pulley, *H*, to receive a driving-belt, *I*.

The wheel is mounted by gudgeons J in bearings K, which are secured upon posts fastened to the sides of the vat at a suitable distance to make the bottom of the wheel clear the floor of the vat.

L L are cleats fastened to the inside of the wheel's rim to move the hides, and M is a door in the side of the vat, near the bottom.

N is a clutch provided upon the shaft, in connection with the pinion E, to stop and start the wheel at pleasure. The clutch would be moved by a handle, as is usual, and enables the operator to disconnect any one of several tumbling-wheels, if more than one be driven by the shaft F.

O is a fastening for one end of the door D, the other end being held in place by inserting it under the iron ring-gear C.

P P are holes formed in the sides of the wheel for the free circulation of the tanning-liquor, so that the contents of the wheel will not be retained in contact with the same fluid continuously; but an automatic exchange of the fluids in the wheel and the tank will be effected by the movement of the wheel.

The operation of the apparatus is as follows: About six feet in diameter is considered a convenient size for the wheel, and the skins are placed in the wheel and rotated in the tan-liquor about three to six revolutions per minute by the application of suitable power to the shaft F. The skins, when stirred by the movement of the wheel, tend to float more or less in the liquor, and are constantly moved about in a current created by the movement of the wheel. The liquor outside the wheel is raised a little by its contact with the periphery of the latter at one side, and correspondingly depressed at the opposite side, where the wheel's rim is descending, thus producing a change of level in the liquor at the front and rear of the tank. The liquor inside the wheel is similarly affected, and thus tends to flow from the apertures P at one part of the wheel and into the apertures at another part, thus securing the circulation desired. When the operation is continued a suitable length of time, the door is opened and the skins are removed.

The tan-liquor may be removed from the vat either before or after the removal of the skins, as preferred, and fresh liquor

may be furnished to the vat, without stopping the wheel, by drawing off a portion of the spent liquor at a time and supplying an equal amount of fresh.

Section III. Putting-out Machines for Morocco.

The work of "putting out" goat and sheep-skins in the process of manufacturing Morocco leather is commonly done by hand; but during the past few years machines have been invented for this purpose that are steadily coming into use.

The skin is "put out" after being taken out of the tanning-vat, and previous to being hung up to dry. The object is to press out the water and tanning liquor, and to scrape off the small pieces of flesh or other imperfections that adhere to the flesh side of the skin, and to render the grain side smooth and otherwise to improve its appearance.

Fig. 257 shows a perspective view of Vaughn's machine for "putting out" skins, and it also claims to do other work, such as unhairing, fleshing, scouring, and "setting out" hides and skins. This machine is patented in all the principal countries. The machine is very efficient, and it leaves the skins dry, even smooth, and in a most desirable condition.

Necks, butts, and shanks are also put out by it in a better manner than it is possible to perform the work by hand. The measurement of nearly all skins put out by this machine is increased fully five per cent. over hand work.

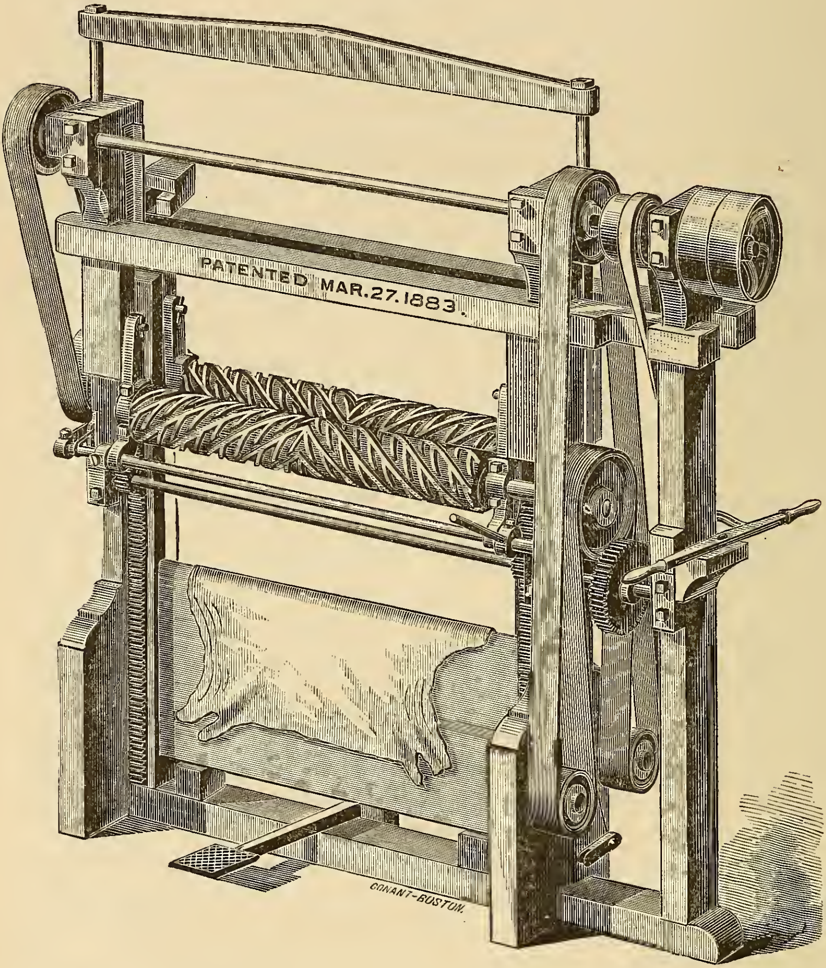
Hoffman's Putting-out Machine is shown in detail in Figs. 258 to 261. It is a cheaper machine than the one shown in Fig. 257, and it may be used for goat, sheep, or calf-skins.

Figure 258 is a back view of Hoffman's machine. Fig. 259 a side elevation, showing a portion of one of the pulleys broken away, so as to expose the pinion and spur-wheel on the other side of it. Fig. 260 is a cross-section through the machine, and Fig. 261 is a front elevation of the machine complete.

The frame a of the machine is constructed of wood; a' is the putting-out cylinder, provided with the spiral blades a^2. The cylinder a' is usually made of wood, and the spiral blades are of thin strips of brass rigidly secured thereto. They are arranged,

as shown, to meet near the centre of the cylinder, so that the spirals on each side run in opposite directions. The object of

Fig. 257.



this is to cause the skins to be stretched each way during the operation of the machine. This cylinder is provided with journals a^3 a^4, arranged in boxes made in any well-known way. The driving-pulley a^5 (see Fig. 259) is connected directly to the journal or shaft a^4, and consequently with the cylinder.

a^6 represents a small pulley rigidly secured to the journal or shaft a^3. This pulley is connected by a belt, b, to a larger

Fig. 258.

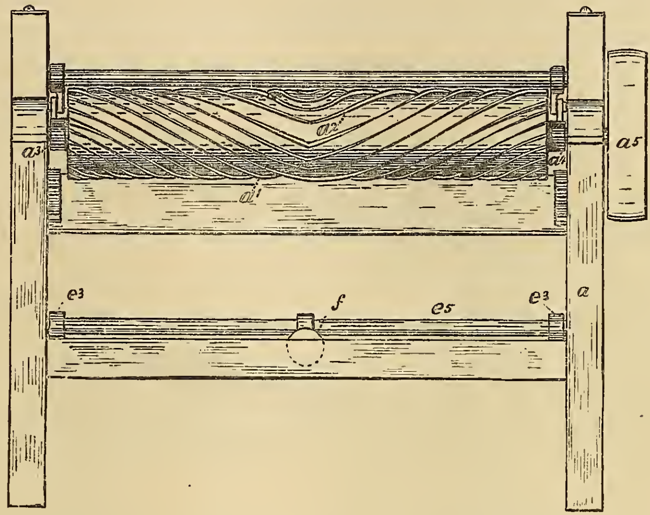
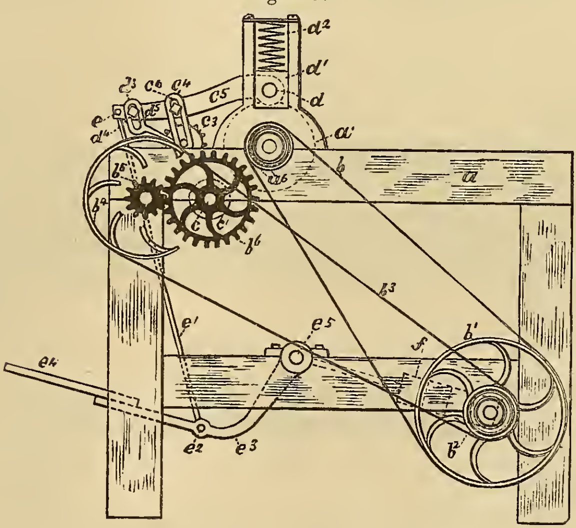


Fig. 259.



pulley, b'. On the shaft of the pulley b' is secured a smaller pulley, b^2, from which a belt, b^3, passes to the pulley b^4. On the

inside of the pulley b^4 is a pinion, b^5, which gears into a spur-wheel, b^6, which is connected to the shaft c of the wooden roller c'. (See Fig. 260.)

Fig. 260.

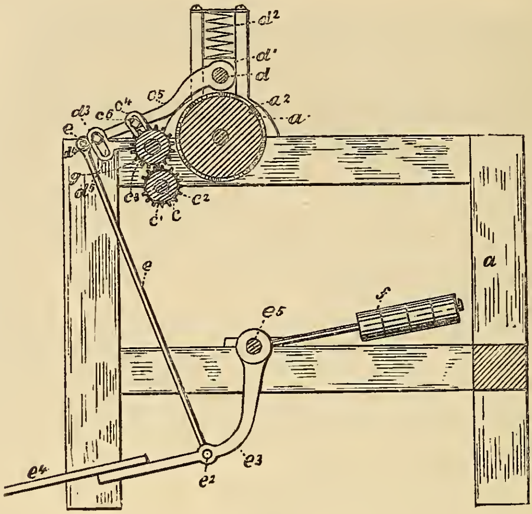
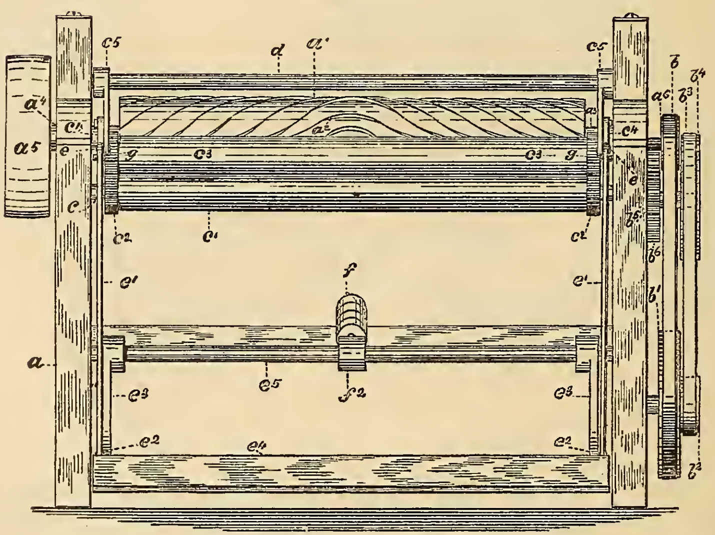


Fig. 261.



The object of the belts is to give a much slower motion to the roller c' than the motion of the cylinder a', the motion of the cylinder being about three hundred and fifty revolutions, and the motion of the roller c' about twenty-five. On the inside of the frame is a pinion, c^2, near either one or both sides of the frame. It is connected to the shaft of the roller c', and turns with it.

c^3 represents a roller made of some yielding material—India-rubber for instance. This roller is mounted in boxes in the slotted arms c^4, which are connected to the arms c^5 by means of a bolt and nut, the bolt passing through the slots c^6 into the arms c^5, so that the roller may be thereby rigidly secured to the arms and be capable of an adjustment to or from them. The arms c^5 are rigidly fastened to the shaft d, which shaft is mounted in boxes d'. The boxes d' are set in place (see Figs. 259 and 260) so as to be capable of a movement up or down, and are kept down by a spiral or other spring, d^2. The roller c' is made of a hard wood, and is secured in boxes in the frame. (See Figs. 259 and 260.)

d^3 represents a slotted arm secured to the arm c^5 by means of a bolt, d^4, which passes through the slot d^5. It will be seen that this arm is made adjustable. Its object is to secure the adjustment of the roller c^3 to or from the putting-out cylinder, after which it is rigidly secured in place by the bolt d^4. There are two arms, c^5—one at each side of the machine. At the outer ends of the arms is jointed by a pin, e, in the usual way, a connecting-rod, e'—one on each arm. The opposite ends of these connecting-rods are secured in a similar way by pins e^2 to the arms e^3 of the foot-step e^4. The arms e^3 are connected to a shaft e^5. A counter-weight, f, on the shaft e^5 causes the foot-step to rise after the pressure of the foot is taken off of it.

In operating the machine the skin is thrown over the roller c^3 and the rollers started slightly by hand, until the skin is far enough in to be caught between the rollers c^3 and c'. A pressure on the foot-step then brings the two rollers together, and still greater pressure brings the roller c^3 and the skin against the cylinder by lifting the box d' up against the spring d^2; this cylinder revolves rapidly and cleans off the small pieces of

flesh or other matter adhering to the skin. It also takes out the wrinkles or other imperfections, and stretches the skin both ways, as above mentioned, so as to leave it smooth and clear. This operation finishes one-half of the skin. It is then taken out and the opposite end treated in the same way, thereby completing it. By this arrangement the skin is first gripped firmly between the rollers c' c^3, which hold it and cause it to move with the required speed. By increasing the pressure slightly on the foot-step the roller c^3 is brought toward the putting-out cylinder, and the skin is brought in contact with it, and is slowly carried past it, moving in a direction contrary to the movement of the putting-out cylinder. One advantage in thus being able to first bring the rollers c' c^3 together is that it enables the operator to wring out the water from the skin, if at any time necessary, before bringing the skin in contact with the putting-out cylinder, which is often necessary on account of holes in the skin. It will also be noticed that as the rollers c' c^3 are brought together the wheels c^2 g are brought into gear, and as the roller c' is continually turning it thereby imparts its movements to the roller c^3 until released from it. The skin being put over the roller c^3 is always in sight, and thereby enables the operator to let off the pressure of the skin from the putting-out cylinder when coming to a hole or a spot on the skin that may be tearing.

List of all Patents for Putting-Out Machines, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
274,858 } 274,859 }	Mar. 27, 1883.	J. W. Vaughn,	Peabody, Mass.
288,941	Nov. 20, 1883.	W. M. Hoffman,	

Leather Fluffing and Grounding Machines.

No.	Date.	Inventor.	Residence.
235,249	Dec. 7, 1880.	J. M. Jones,	Wrexham, N. Wales, Great Britain.

List of all Patents for Machines for Evening or Making Leather of Uniform Thickness, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
69,219	Sept. 24, 1867.	W. C. Joslin,	West Thompson, Conn.
147,770	Feb. 24, 1874.	C. Handy and C. E. Morrill,	
152,811	July 7, 1874.	J. Pullman and J. R. Edmonds,	Wonerch, England.
270,964	Jan. 23, 1883.	J. D. McDonald,	Woburn, Mass.

Section IV. Compounds for producing Imitation of Grain or Morocco Leather.

This invention, which is that of Mr. Hugh Smith, Newark, N. J., consists in producing from split or buffed leather an imitation of grain leather or Morocco, made from any kind of skins or hides, by the use of certain compounds; the first consists of glue, one-quarter to one pound, dissolved in one gallon of water, and boiled, after which is added thereto one-quarter to one pound of starch or flour, and the whole mixture is again allowed to boil, after which aniline colors or paints of any kind may be added; also, use from one to four pounds of glycerine or other fatty substance, and mix therewith any desired colors of paints to correspond with the colors of the dyes. The whole is mixed together. Of this compound one or more coats may be used previous to graining or pebbling the leather under treatment, the object of which is to fill up the pores, and bind down the fibre or nap on the surface; and if it is not required to be water-proof, it may be finished with one or more coats of a suitable varnish.

The second compound, which is used to make the leather more flexible and water-proof, consists in a syrupy solution of the following ingredients, and in about the following proportions: One pound of gum-shellac dissolved in two quarts of alcohol, added thereto or used separately; one pound of India-rubber or other equivalent gum, also dissolved in one gallon of naphtha (the latter should be dissolved in a separate vessel previous to mixing with the former), and adding thereto

a sufficient quantity of glycerine to soften, together with the proper or desired coloring matter. If this mixture should be too thick, it may be reduced by adding wood-alcohol or its chemical equivalent until the desired result is obtained.

These compounds are to be applied to the leather in the known manner, and for the purpose of coverings or coatings thereto.

The leather is first split or buffed in the ordinary manner, and dyed, if preferred, any desirable color. It is then secured to frames, or spread or sticked out upon a table, preparatory to having the coloring matter and compound applied, which is done with a sponge, brush, swab, or any other suitable device, and well rubbed in upon the surface of the split or buffed side of the leather, one or more coats, either warm or cold, being applied, until a uniform color and smooth surface are produced, which, after being properly dried, is grained, to imitate the natural grain of the leather or Morocco or other design, as the case may be, the first preparatory coating to be applied previous to the graining or pebbling process.

Process for Finishing Lower Grades of Leather similar to Morocco.

In preparing leather for market, metallic salts have been used, and with other chemical compounds and dyes been made to combine with the substance of the leather for the purpose of rendering the material impervious to moisture, and thus to strengthen the fibre and give it a suitable color and finish for the various manufacturing purposes. The fibre of leather not being readily absorbent of compounds containing metallic salts, the beneficial effect of the treatment has been confined to skins or leather of the higher grades of quality only. The material has been found not to retain permanently the metallic salts or color of the dye, and is liable to exude. The metallic salts and coloring-matter thus injure the appearance of the leather, causing the color to fade and the leather to crack, thus rendering the usual methods objectionable on account of the higher grade of skins it is applicable to and the want of permanence in finish.

The object of the present method is to provide a process for finishing leather which will render the fibre of the leather of

all grades more absorbent of the chemical compounds and dyes, and will also set and retain the color and the metallic bases of the compounds used, and give a durable finish to leather of all grades, and make the lowest grades susceptible of a finish equal to Morocco leather.

The process consists in the previous use of a certain preparatory solution and dyeing compounds, in combination with a secondary and a perfecting compound applied and used in the manner and order and composed of the ingredients as will be described, one essential requisite of this process being that the treatment shall be followed strictly in the order here designated.

For the first part of this process, after the leather has been tanned and shaved in the ordinary way, saturate with a liquid compound composed of a hot solution of logwood made by boiling ten pounds of logwood-chips in forty-five gallons of water until reduced to twenty-five gallons, which is designated the "preparatory solution." Second, the leather is then put on tables for stretching and taking the water out, then hung up and partially dried. Third, sammy it, then put out on the tables the second time. Fourth, if it is Morocco and required to be straight-grained or pebbled, do so by the use of an arm-board or machinery. Fifth, it is then blackened by the use of a liquid compound composed of a solution of iron, vinegar, and animal-blood, either warm or coagulated, made by suspending eight pounds of iron in forty gallons of vinegar, thirty grains test, for three weeks; and to one quart of this solution add half a pint of animal-blood, either warm or coagulated, and this application is sometimes repeated; then hang up the skins and allow them to dry; or the leather may be blackened by dyeing in trays, by saturating with a liquid compound composed as follows: Say copperas, one pound; nitrate of iron, one pound; verdigris, one-half pound; chromate of potash, two ounces; Sicily sumach, two pounds; soda-ash, one-fourth pound; pulverized nut-galls, two pounds; water, forty gallons. To color leather buff and grain it, add to this last solution four ounces of animal-blood to the quart, and put it on with brush or sponge on the table. Sixth, if a bright finish is desired, glaze with the glazing-machine or on the table with a glass or flint. If a dull finish

is desired do not glaze, but brush on the face with a brush. Seventh, soften on the table by use of board or slicker. Eighth, oil the face of the leather, after which the process is continued as follows:—

For the second part of this process use a chemical compound which consists of, say one part of dry gelatine (isinglass or other like substance) dissolved in four parts of oil, including a small quantity of sulphuric or other acid, and when these are combined by means of heat, five parts, or thereabout, of an alkaline solution of caustic soda are added at a specific gravity of about 26° Baumé, the whole being stirred while yet warm, and the result is a chemical combination which is designated the "secondary compound."

For the third part of the process use a chemical compound which is designated the "perfecting compound," and which is prepared as follows: In one vessel is prepared a strong solution of one of the alums—for instance, of the sulphate of alumina—with potassa or either ammonia or soda as equivalent. In another vessel is prepared a solution of the sulphate of zinc, and in a third vessel a solution of the acetate of lead. These solutions are each to be of the same density. When prepared the two sulphate solutions are mixed in the proportions of about five parts of the first to one and a half parts of the latter, and to these are added about five and a half parts of the acetate-of-lead solution. By the chemical action that ensues sulphate of lead is formed, and when this has subsided the clear liquid is drawn off and is reduced to the proper density, which is 1° to 2° Baumé.

The manner of continuing the treatment of leather to be finished is as follows: A bath is prepared with, say half an ounce of the secondary compound dissolved in two gallons of hot water—that is, in about these proportions. This is used when cold. To treat leather the patentees, Moses B. Tice and Nicholas O'Connell, steep it in this bath till endued with its properties and then drain it. When the leather has been removed from the bath of the secondary compound and is well drained, they steep it in a bath of the perfecting compound, where it remains from eight to twelve hours, and when well

drained it is gradually dried, which completes the finishing process. After the finishing process is thus complete the leather is again softened by use of board or slicker, then oiled to bring the color out and make it soft and pliable, and properly prepared and ready for manufacturing purposes. This finishing process gives to leather of all grades a satin finish which is very durable.

The preparatory solution, by being first applied, and then the liquid compounds for coloring being afterward applied, fasten the color at once, and there is not required so much of coloring-matter as heretofore used, which is beneficial to the leather, for the reason that the less coloring-matter used the stronger is the leather, and by thus coloring before using the other finishing compound, which has not heretofore been done, the color is fastened, and will not fade or come out.

CHAPTER XXXIII.

TANNING AND FINISHING SHEEP-SKINS.

SECTION I. TANNING AND FINISHING SHEEP-SKIN FLESHERS FOR LININGS, BINDERS, AND SKIVERS.

THE manufacture of sheep-skins into linings, bindings, and skivers, for use in the production of boots and shoes of all grades, is an important one. In this country the majority of the sheep-skins used for this purpose are consumed in the State of Massachusetts, the large production of boots and shoes at Lynn and other places in that State creating the demand for this class of leather.

The sheep-skins used are both domestic and foreign; those derived from Great Britain are mostly "sheep-skin fleshers," and are treated with vitriol before shipment to preserve them.

The materials used for tanning this variety of leather are usually hemlock bark, sumach, and alum.

These skins are finished in all colors; hemlock is used for colors darker than its own, sumach is employed for white and fancy colors, and alum mostly for those that are to be dyed black.

The compounds and machines employed for depilating and pulling wool from sheep-skins have been explained in Chapters XV. and XVI., and machines for splitting them are shown in Chapter XX.

The sheep-skin fleshers are split from the sheep-skins while in a state of pelt, and special machines are required for this operation.

The processes which we shall first describe are for those skins which arrive at the tannery from foreign countries, split, free from wool and which are green salted.

Sometimes these skins are placed in clean water and washed; but they are not uncommonly removed from the casks in which they were shipped and immediately soaked and placed in the tanning liquor, whether it be hemlock, sumach, or alum.

In hemlock and sumach they remain about ten or twelve days, the strength of these liquors being gradually increased every thirty-six hours, and in alum the skins remain for a much shorter time. After being tanned, they are removed from the vats with a hook and piled, and left to drain, as shown in Fig. 263.

The skins are then carried to the drying lofts and each one hung upon two hooks, but so placed that the skins do not touch.

Fig. 264 shows an interior view of a drying loft in a sheep-skin tannery, with the skins hanging upon hooks to dry.

Fig. 262 shows an exterior perspective view of a sheep-skin tannery, and the slat openings into the drying lofts for the free admission of air.

After being dried the skins are removed from the hooks in the drying loft, and transferred to the "putting out department," where they are wetted and tacked to boards used for putting out. After this operation they are again hung up in the loft to dry, and then carried to the "finishing-room" and finished on the machines employed for that purpose, but if they

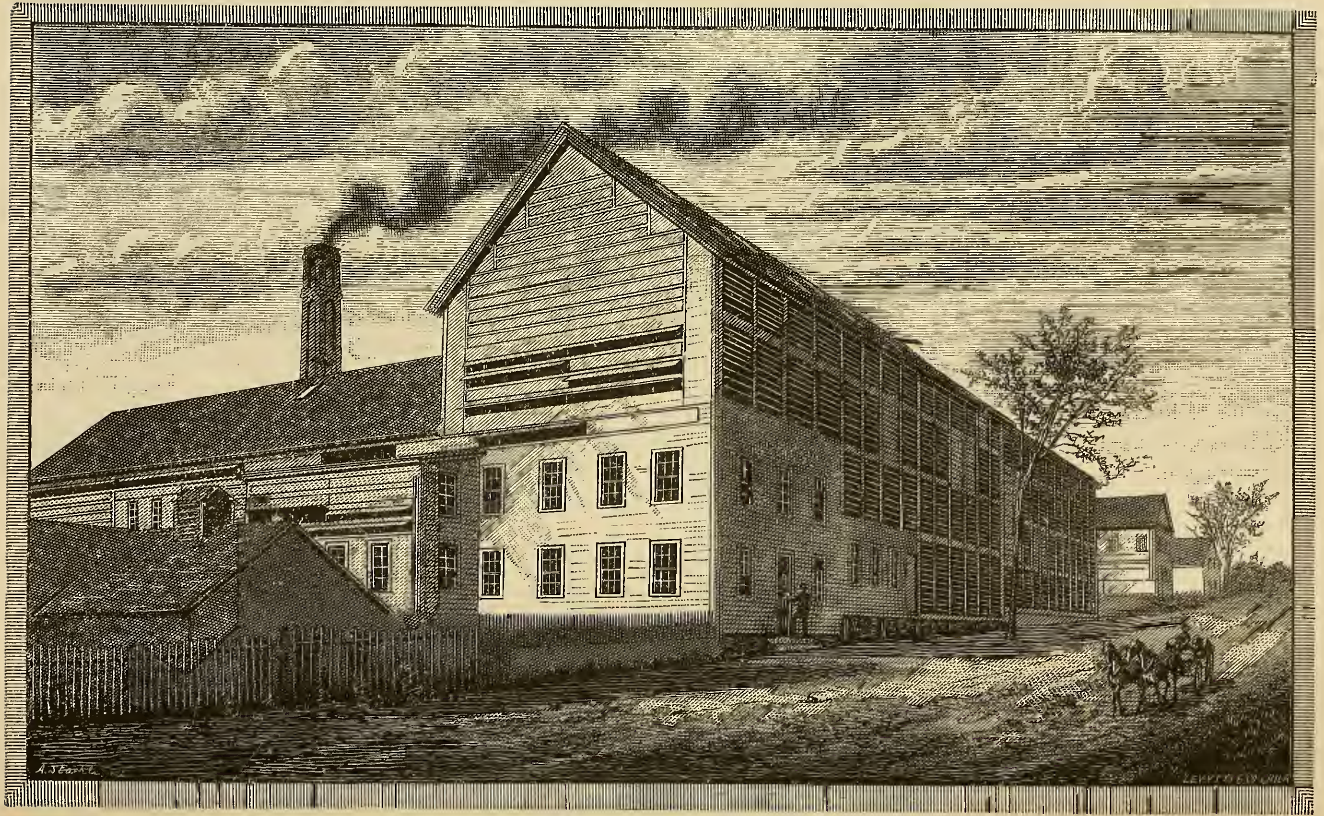


Fig. 262. Exterior View of a Sheep-skin Tannery. Page 556.

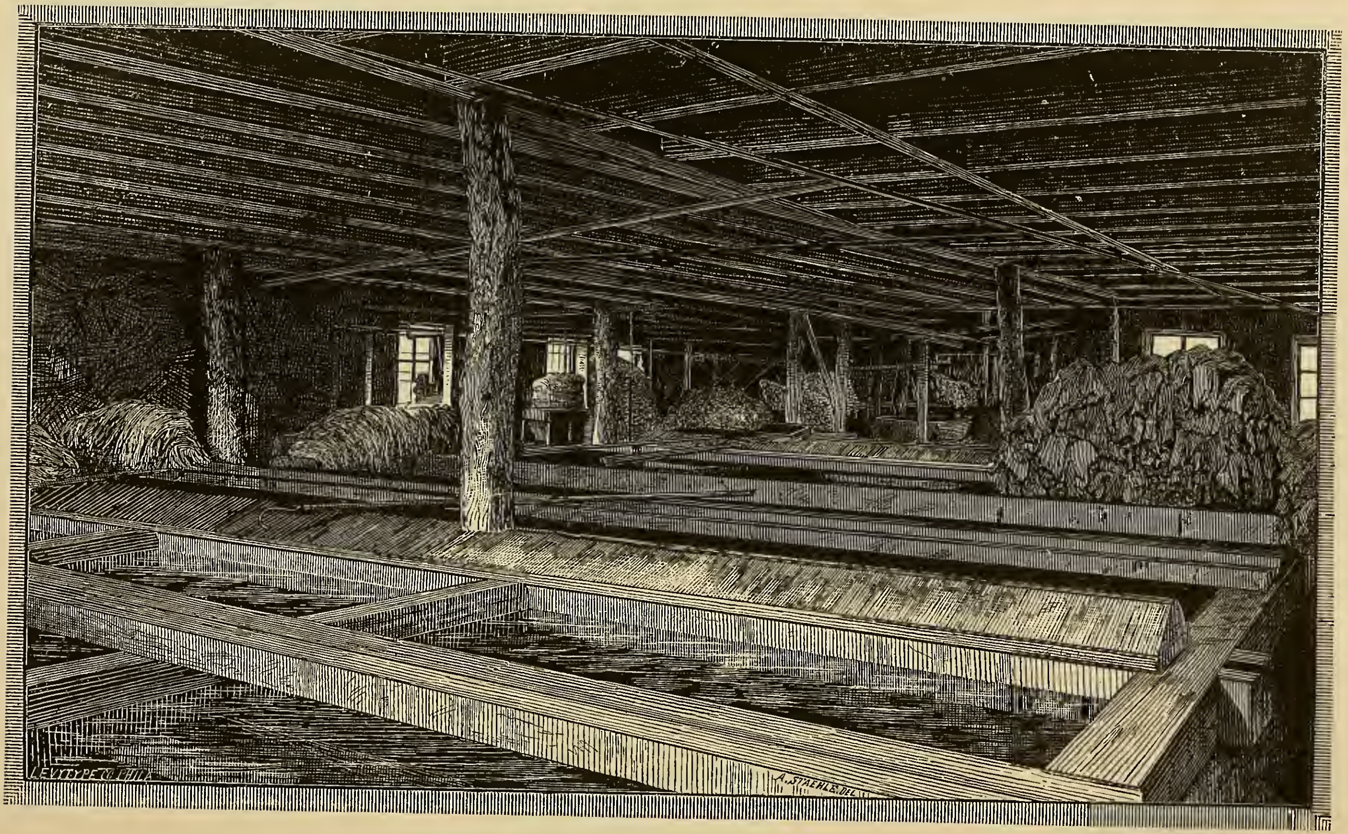


Fig. 263. Tanning-vats in a Sheep-skin Tannery. Page 556.

Fig. 264. Drying-loft in a Sheep-skin Tannery. Page 556.

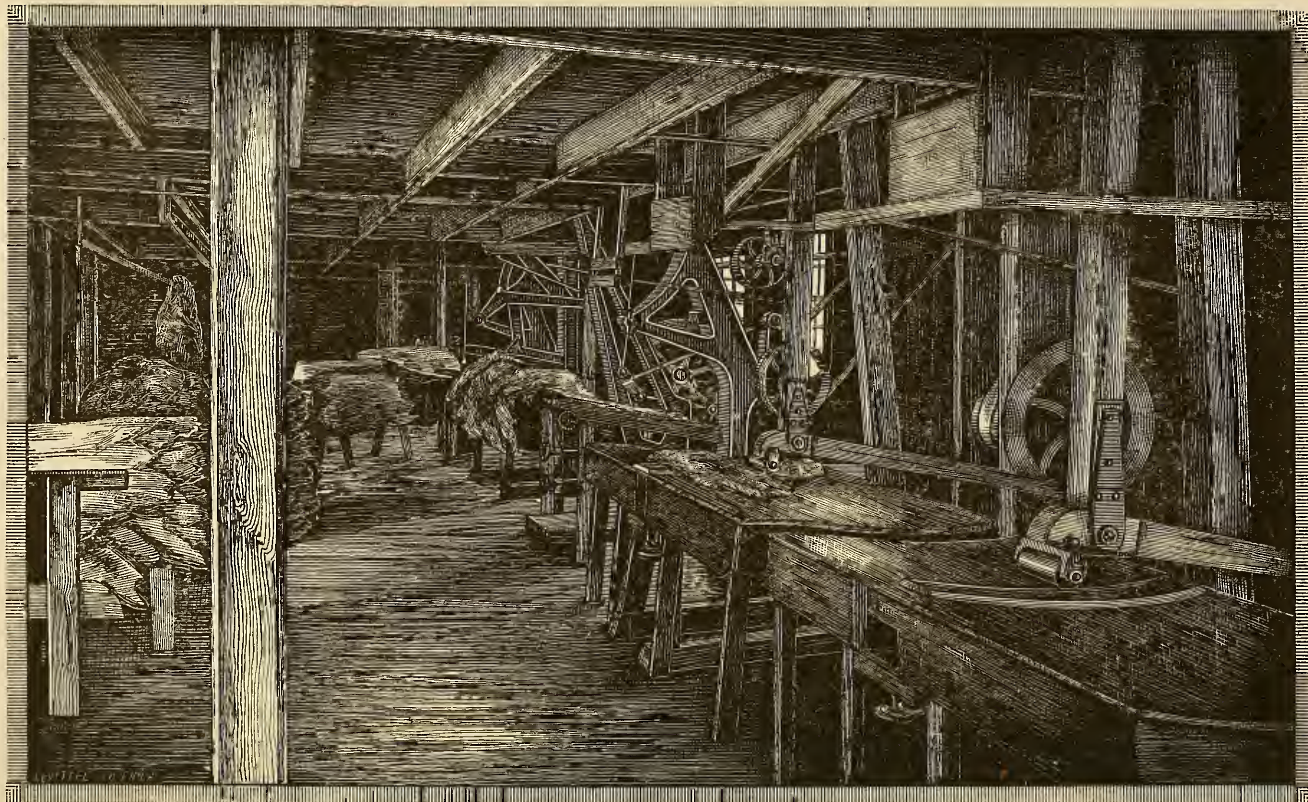


Fig. 265. Finishing-room in a Sheep-skin Tannery. Page 557.

are to be dyed, they are carried to the dye-house and colored in various hues, aniline colors being generally employed. Different receipts for dyeing sumach-tanned skivers and the dyeing of alum tanned and other varieties of leather are enlarged upon in Chapter XLIII. The reader is, therefore, referred to that portion of this volume for information upon the dyeing processes.

After being dyed the skins are again hung up in the lofts to dry, and are next carried to the finishing department, shown in Fig. 265, and rolled, glassed, or pebbled by machines used for the purpose, and which have been illustrated and explained in detail in Chapter XXVI.

After being finished on the machines, the skins are measured, marked, and bundled ready for market.

Dressing Sheep-Skin Fleshers for Glove Bindings, etc.

The following process for dressing "sheep-skin fleshers," to be used in the manufacture of gloves, for hidings, etc., was patented in 1875, by Richard Hart, of Gloversville, N. Y.

The quantity of the mixtures to be specified is intended for about two dozen sheep-skin fleshers of the ordinary size. In carrying out the process, first immerse, pound, and stir the skins for about one-half hour in a fluid mixture, prepared as follows: Dissolve one pound of alum in one and a half gallons of water, which is readily done by boiling. Then mix, in a separate vessel, one-half pound each of flour and oatmeal, or one pound of either alone, with one gill of oil and one and a half gallons of water, and mix this composition with the alum-water. At the expiration of the designated time take the skins out of this mixture and stretch them, and remove the groundwork and knife-marks from the grain side. Then immerse them for about the same length of time, and with the same manipulations as before, in a fluid mixture, prepared as follows: One gill of urine, one-half bar of bar-soap, one-half ounce of soda, one-half pound of salt, and about two ounces of whiting or ochre, all boiled in one and a half gallons of water until they are thoroughly dissolved, to which are added one-half pound of flour and one-half pound of oatmeal, or one pound of either alone, mixed in one and a half gallons of cold water. The skins are then dried, stretched,

and staked out, and can now be faced or finished upon either side in the usual manner.

Instead of urine in the mixture last described, a small quantity of ammonia may be used, as it produces the same effect; or the proportion of soda may be suitably increased, and neither urine nor ammonia be employed, and still the desired result obtained.

Skins dressed by the usual method can be finished or faced on the flesh side only, and have a rough and hard surface on the grain side, besides being rough and stiff in texture.

Skins dressed by this process, by treatment to both mixtures, may be finished on either or both sides, and, it is claimed, are made soft, pliable, and with elasticity or "spread," and stronger in texture, without becoming rough.

Skins which are treated to the first mixture only may be at once dried, staked, and stretched, and finished on either or both sides in the usual manner, without subjecting them to the second mixture, and, it is claimed, will then be better in quality, and have a susceptibility of better finish, than skins dressed in the ordinary way; but it is preferable to employ the entire process in dressing skins, as they are thus given a superior quality and a capacity for higher finish than when the first part of the process only is used, and, when finished, bear a close resemblance, in texture and quality, to deer-skin or castor.

Section II. Improved Methods for Tawing and Dressing Sheep-Skins.

Manasse's Method for Tawing Sheep-Skins.

In 1875 Emanuel Manasse, of Napa, California, patented the following process for tawing sheep-skins :—

The skins are taken from the sweat-house, and, after being properly treated in the beam-house, are immersed in a solution composed for two hundred skins of the following ingredients :—

No. 1. Twenty pounds of salt, thirty pounds of white-rock potash, three hundred gallons of water.

The skins remain in this solution for about two hours, and are then wrung out dry, and immersed in a solution composed as follows :—

No. 2. Twelve pounds of hard soap and two gallons of neat's foot oil in one hundred and fifty gallons of water.

After being kept in this solution long enough to wet them through, the skins are removed and hung up to dry, and are wet and dried in this manner two or three times.

After being thus treated and properly tawed, they are put in a dry state into clear water, and washed in a thorough manner to remove all foreign matter from them, and in this moist condition are dried to produce leather of various colors, or, if a white leather is required, they are allowed to dry without further treating.

The proportions of the ingredients given above may be changed, as the nature of the skins requires, without affecting the process.

It is claimed that the skins thus treated combine the qualities of softness, pliability, and toughness, which allow the leather to be sewed together, as in the manufacture of gloves and like articles, without tearing or allowing the stitches to pull out.

Hibbard's Process for Preparing and Tanning Sheep-Skins.

Hibbard's process for preparing and tanning sheep-skins for linings, binders, etc., is as follows:—

To remove the hair mix the following composition with water sufficient to make a thick paste, apply it to the flesh side of the hides, fold the skins and keep them at a temperature of summer heat. In a few hours they are ready to pull.

Quicklime (freshly slacked) . . .	$\frac{1}{2}$ bushel.
Wood ashes	$\frac{1}{2}$ "
Salt	3 pints.

For the liming process use the same composition, mixed with sufficient water in a vat to immerse the number of skins proposed to be limed. One bushel is equivalent to one bushel of lime alone. The liming is done at the temperature of 60° F.

For tanning six dozen full sized sheep, deer, goat, or similar skins, prepare the following composition:—

Salt	18 lbs.
Sulphuric acid	2 "
Sumach or quercitron bark . . .	36 "
Hydrochloric acid	2 ounces.
Dried clover	18 lbs.
Water	125 galls.

Exhaust the sumach or bark by water, add the salt, enough to insure perfect solution, then add the acids and incorporate by stirring.

Hesthal's Process for Dressing Sheep-Skins, etc.

The following process was patented in 1883 by August Hesthal, of San Francisco, Cal., and is useful in the preparation of leather for button-pieces, linings, stays, and other small articles.

The process is especially applicable to sheep, lamb, kid, and deer-skins. The skins after having passed through the sweating process and been properly treated in the beam-house are placed in a solution which we will call No. 1, composed of two pounds of caustic soda, one pound of borax, and sufficient water to cover the skins—say one hundred gallons.

The skins and compound are contained in a suitable drum, in which they are run for a half hour and then removed and hung up to dry.

They are then immersed in a solution which we will call solution No. 2, composed of five pounds of hard soap, one gallon of straits oil, one-half pound caustic soda, and seventy-five gallons of water.

In this solution they remain long enough to become soft and wet through, after which they are put into a drum with a part of the composition No. 2 and run for about a half hour, being then removed and dried as before.

They are next softened in the composition No. 2 and then allowed to drip.

They are then placed again in the drum with a solution which we will call No. 3, and run for about a half hour; then put back into the composition No. 2 and soaked for one hour,

and then taken out and hung up to dry, after which they are soaked and dried in this manner two or three times in composition No. 2 until they are properly prepared, as some skins may need to have this part of the process repeated a greater number of times than others. After the skins are treated in this manner and have become leather, they are put in a very weak solution of composition No. 2, in order to thoroughly soften them, and in this wet condition they are dyed in different colors; or, if white leather is required, they are allowed to dry without further treating. In this manner is produced a leather which is strong and pliable, and when sewed together it does not crack, nor do the stitches pull out; and as the skins are prepared without the employment of lime and sulphuric acid, it leaves the fibres in their natural state and strength.

The proportions of the ingredients given in the above solutions, Nos. 1, 2, and 3, are estimated for about one hundred and twenty sheep-skins.

Section III. Artificial Sheep-Skins for Linings.

Artificial leather does not properly come under the head of tanning; but in a book that treats of the whole subject of leather manufacture as broadly as does the present volume, it would probably be more out of place to omit such subjects than to include them. Especially is this so when such materials are in common use in this country and in Europe, and are employed in the manufacture of cheap boots and shoes.

Evans's imitation sheep-skins are prepared as follows:—

Having selected a base of closely-woven cotton cloth or other fabric, of ordinary width and of any desired length, spread upon it in successive layers a composition of caoutchouc or India-rubber, and shellac, gasoline or naphtha, zinc-white, clay, or plaster-of-Paris, of sufficient thickness and body not to spread or run too easily.

Each layer is thoroughly dried before the next coating is applied; and better results are obtained by making the coats thin and applying them oftener—say as many as six or seven successive applications of the composition—for the reasons that

a thin coating is more evenly spread on the fabric than a thick one, and dries more quickly and more uniformly, so that as many as six or seven thin coatings can be applied to the fabric, and each one be thoroughly dried before the next following is spread, in the time that it would take for spreading one thick coating and in drying the same; and the result of the thin-layer process is far superior to the thick-coating method, as the first layer is thoroughly incorporated or knit into the fabric before the others are applied, and each successive layer is thoroughly and firmly attached to each preceding layer.

After the last coating is wholly dry apply a surfacing of any one of the aniline colors, somewhat stiffened by the addition of French chalk or magnesia, which after being thoroughly mixed, is spread upon the base as prepared, in much the same way as the first-named composition is applied, excepting that but one coating of the preparation is put on.

After this last-named coloring-coat is dry, the fabric is passed through a pebbling-machine, to provide it with a surface-finish that shall more closely resemble the pebbled sheep-skins used for the linings of boots and shoes.

The product of this series of manipulations, it is claimed, possesses a softness of finish that renders its detection from sheepskin by the touch alone almost impossible, while its strength and wearing qualities are good, and its cost is materially less.

In preparing the composition first applied, cut the caoutchouc or India-rubber with gasoline or naphtha; then add to that mixture a proper quantity of shellac, zinc-white, clay, and plaster-of-Paris, about in the proportion of one part shellac, two parts zinc-white, one part clay, one part plaster-of-Paris. These ingredients are thoroughly incorporated with each other before use. Of course the proportion of the parts may be changed if desirable. Enough French chalk or magnesia is employed to somewhat thicken the aniline.

In the manufacture of this article the patentee takes about three hundred yards of the fibrous base and winds it on a feed-roller, from which it is fed under a reservoir containing a quantity of the first-named preparation, which is dripped therefrom on the fabric immediately in front of a spreading-knife

for equally distributing the coating on the cloth. From the spreading-knife the cloth, having one coating, is carried over a drying-roller under another reservoir, from which is sprinkled the composition which is spread by a second spreading-knife over the first coating. The cloth now having two coats of the filling composition, is drawn over another drying-roller from which it passes back to a roller immediately under the feed-roller, to be again drawn through the machine to receive additional coatings.

Although other filling having an alumina base may be employed in place of the zinc-white, clay, and plaster-of-Paris, yet the best results are secured by their use.

CHAPTER XXXIV.

LACE LEATHER.

Lace leathers are either tanned, tawed, or made from raw hides, and both these varieties as well as picker leathers which are used for looms, and also for hamestrings, are generally produced in the same tannery. But the variety of lace leather which we shall describe in this chapter is the lighter kind, which is manufactured usually from Calcutta hides, the heavier variety being made from light cow-hides.

When the dry Calcutta hides are used they are first placed to soak in a vat of water, and the time which they remain is dependent upon the weather, one or two nights in warm weather and three or four nights in cold weather being the usual time.

They are next softened in the hide-mill, the time which they are worked depending upon the manner in which the hides have been cured.

In order to cleanse them from dirt the hides are next placed

in the wash-mill and worked for fifteen or twenty minutes, which operation also removes the wrinkles.

Upon being removed from the wash-mill, the hides are spread flat upon the floor and slit down the back and thus divided into sides.

They are then placed upon trucks and carried to the lime-vats, where they are spread flat upon the floor alongside the vats and whitewashed, by passing over them a swab which has been dipped in a solution of lime.

This coat of whitewash is applied to the hair side, and the sides are piled two hundred high, and in warm weather this pack remains over night, but in winter the sides are placed in the lime-vats the same day, in order to prevent the whitewash from chilling. In warm weather the sides remain in the limes about ten days, but in cold weather the period is longer.

When the hair is loosened the sides are removed from the vats with tongs and immediately unhaired, after which they are placed in water in a vat having a revolving paddle wheel and washed, the England wheel and vat shown in Fig. 112 being the one commonly employed and upon removal are worked on the beam to remove the lime.

As a further preventive against lime the sides are placed in a large revolving wheel, called a "tub wheel," in which they are washed for about three-quarters of an hour, and upon removal from this wheel the sides are placed in the tanning liquors and remain until tanned. When this has been accomplished the sides are exposed to the air to dry and next stretched, a machine for which purpose is shown in Figs. 266 to 268; but the stretching is also performed by hand on the stretch-bench.

As is well known, all hides vary considerably in thickness at different points, and when taken from the liquor-vats they are found to be soft, flabby, wrinkled, and fulled. Owing, therefore, to this condition of the hides, it is necessary, before they are dressed and finished for the market, that they be stretched throughout to remove the wrinkles and fulness, and also to reduce those parts which are thicker than other portions, so that, as far as possible, the hides shall be uniform in thickness.

Mechanical devices are capable of producing, in connection with hand manipulation, the desirable results of thoroughly stretching the hides, and rendering them of even thickness in all parts. These devices usually comprise, in the main, a friction table or beam, over which the hides are dragged, a stretcher-bar of suitable form for stretching the hides transversely, and a slowly-revolving roller, to which the edge of each hide is secured, and around which it is wound after being drawn over the table or beam and the stretcher-bar. After the sides have been well worked on the stretch-bench they are split evenly by the splitting machine.

The sides are next stuffed with tallow and neat's-foot oil, the proportions of which change somewhat according to the temperature and season, less oil and more tallow being used in summer than in winter.

The sides are then hung upon sticks in tiers in the drying-room, which is commonly heated by exhaust steam from the engine.

After being removed from the drying-room the sides are softened, the machine shown in Figs. 269 to 277 being now usually employed for this purpose in place of the old-fashioned pin-block.

The sides are next rolled out smoothly on a glassing machine, and are next shaved on the flesh side and buffed with a currier's knife, in which latter operation the grain is removed in order to prevent the lacing from cracking; about seventy-five sides being a fair day's work for one man. They are then rubbed with a mixture of lard oil, tallow, and flour, and the sides of lace-leather are then finished by laying them upon a flat table and smoothing them out with a glass slicker.

Junior's Methods of Manufacturing Lace-Leather.

The following process for manufacturing lace-leather is used by Junior of Belleville, Ill.. There is no patent on the process, but Mr. Junior claims one on the tanning compound.

The hides in this method go through the following processes:—

First. Soak the hides in fresh water for twenty-four hours.

Second. Soak the hides in freshly slaked lime-water as long as necessary to make the hair removable by scraping.

Third. Put the unhaired hides into fresh lime-water once more for two days.

Fourth. Scrape off all fleshy parts on the inside; then soak the hides in fresh water to free them from all lime.

Fifth. Then rub the hides with a "slick-stone," in order to smooth or burnish them and to squeeze out all impurities.

Sixth. Soak the hides for about twelve hours in warm water, containing one pound of wheat bran and one-half pound of a ferment to every five gallons of water, until the hides cease to swell, and all lime is neutralized.

Seventh. Then squeeze them well with the scrape-iron.

Eighth. Immerse the hides in the composition given below, in which they remain for from twelve to twenty-four hours until they are well saturated.

This composition consists of the following ingredients combined in proportions stated: For every ten pounds of hide—pure water, five gallons; alum, one pound; sal-soda, four ounces; common salt, four ounces; wheat bran (or other bran), four ounces. Of these ingredients the crystalline salts should be thoroughly dissolved and mingled by agitation with the bran. It is claimed that the application in tanning of this solution, in connection with the other treatment of the hides has the effect of preserving the whole natural strength of the same, which is possible only in the absence of free acids. After the hides have become saturated, they are removed from the solution and hung up to dry.

Ninth. Now work them well on the stretch-bench and split them evenly on the splitting-machine.

Tenth. Rub into the hides a mixture of about three pounds of lard oil and one pound of tallow, and let dry well.

Eleventh. Soak in rain-water containing bran, and in this wet state stretch the hides well on the stretch-bench.

Twelfth. Now shave them as clean as possible on the flesh side, and especially carefully on the grain side, in order to remove the whole grain, which removal produces the elasticity which prevents the liability to cracking.

Thirteenth. Then, finally, rub into the hides a mixture of one and one-half pound of lard oil, one-half pound of tallow, and one-eighth pound of fine flour for every ten pounds of hide (which process helps to produce smoothness and durability of the leather), let them dry, then stretch and smooth them well with a wooden stretcher, and now the hides are ready for use.

Quick Tanning Process for Lace and Whip Leather.

The method patented in 1875 by Bartenbach and Richter, of Detroit, Mich., is as follows:—

For making lace and whip leather the hides are cleaned after soaking, the hair being removed. Then put them in the following solution, enough being used to fairly submerge them: To twenty-five gallons of warm water add two pounds of alum, fifteen pounds of salt, one pound of sulphuric acid, two pounds of wheat bran, two ounces of dissolved sulphur. The hides are left in this solution for twenty to twenty-five minutes, after which one ounce of vitriol, four pounds of salt, and two ounces of alum, dissolved in one-half gallon of water, are mixed with the solution, and the hides are left to remain in it twenty minutes longer. The hides are then taken out and well wrung, and hung up to dry in a dark, airy place. Those intended for whip leather, when dry, are moistened with a little water, and stretched upon a stretching-iron. Those intended for lacing-leather, after being well dried, are rubbed with a mixture of one pound of fish oil, one pound of tallow, four ounces of linseed oil, and two ounces of soap-soda in a gallon of hot water.

Loescher's Method for Manufacturing Lace Leather.

In 1876 H. Loescher, of Chicago, Ill., patented the following method for manufacturing lace leather, the object claimed being to produce lace leather of greater strength and tenacity than that produced by treating skins with lime and acids.

The first step in this process is to remove the hair from the hide by fermentation by subjecting it to a decaying process for a few days. The next step is to dry the skin to a flinty hardness; and the last step consists in subjecting the dried skin to a

process of torsion and beating until thoroughly softened, when, it is claimed that it will have the toughness of rawhide, with the pliability of kid.

Coupe's Stretching Machine.

The machine for stretching leather shown in Figs. 266 to 268 is the invention of Wm. Coupe, of Attleborough, Mass., who is an extensive manufacturer of lace leather.

Fig. 266.

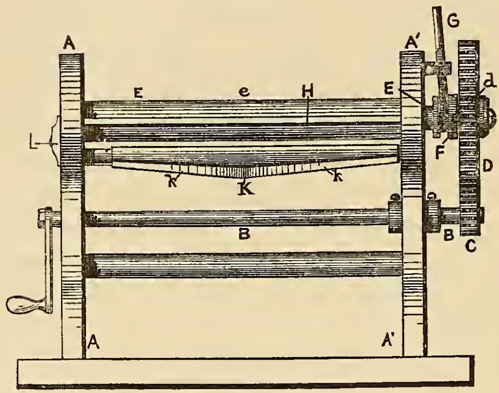


Fig. 267.

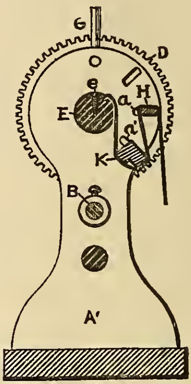


Fig. 268.

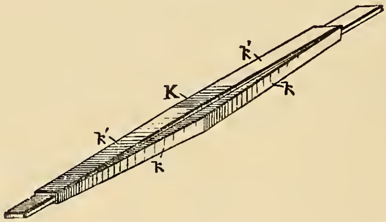


Figure 266 represents a front elevation of Coupe's machine. Fig. 267 shows the same in central vertical transverse section, and Fig. 268 represents the stretcher-bar in perspective.

As particularly shown in Fig. 266 the machine consists of the following devices: A pair of standards as at A A', in which is mounted a shaft, as at B, to which power is applied. Upon one

end on this shaft is a pinion, as at C, arranged to mesh with a gear, as at D, loosely mounted on one end of a roller as at E.

The inner side of this gear D is provided with a clutch face or pin as at d, for engagement with a clutch as at F, splined to the roller E, and furnished with a slipping-handle as at G, so arranged as to be convenient of access to the operating attendant. The remaining parts of the machine consist of a narrow table or breast-beam as at H, which is mounted in mortises as at a, in the standards $A\ A'$, and a stretcher-bar as at K, likewise mounted in mortises as at a', and having its two working faces doubly inclined as at $k\ k'$, Fig. 268.

The operation of the machine is as follows :—

A hide is placed over the table or breast-beam H, and one of its ends carried under the stretcher-bar K, and secured to the roller E by the clamp e, the other end hanging free in front of the machine, as shown in Fig. 267. The operator now connects the roller E to the continuously-revolving gear D by means of the handle G and clutch F, and the roller E slowly revolves, winding the hide around its surface, and drawing it over the friction table or beam H, and around the stretching-bar K.

When any part of the hide, the thickness of which is to be reduced, or the wrinkled or fulled-up portion smoothed out, passes over the table or beam H, the operator who stands in front of the beam applies pressure by hand to the proper portions, thereby increasing the friction between the under surface of the hide and the surface of the bar H, and causing the onward movement of such portions to be retarded. The portions thus pressed upon are more severely stretched than other parts of the hide, and by proper manipulation by the attendant its thickness is rendered uniform, and it passes to the stretching-bar K in a smooth condition, having been longitudinally stretched upon the beam H.

In passing over the bar K the hide is transversely stretched by the doubly-inclined sides $k\ k'$, from which it passes onward to the roller E, winding about the roller uniformly and smoothly. The machine is now stopped, the hide removed, another secured to the roller E, and the operations above described are repeated.

Tidd's Softening Machine.

Figs. 269 to 277 show the machine invented by J. Tidd, of Woburn, Mass., which is much used for softening lace leather.

Fig. 269 is a side, and Fig. 270 an end elevation. Fig. 271 shows the under side of the cross-head G. Fig. 272 is a top view of the bed B. Fig. 273 is the under side of a grooved cross-head. Fig. 274 is the top side of a grooved bed. Fig. 275 is a side view of a grooved cross-head, with a corrugated or serpentine rib l, instead of the pins C. Figs. 276 and 277 are end views of Figs. 273 and 274.

Fig. 269.

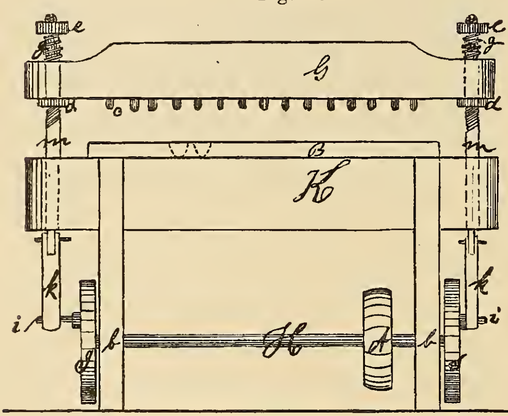


Fig. 270.

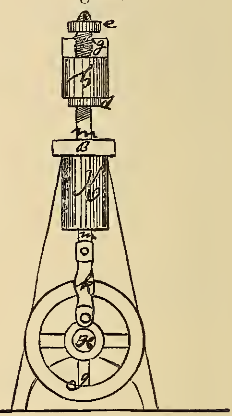


Fig. 271.

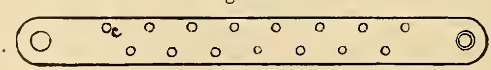


Fig. 272.

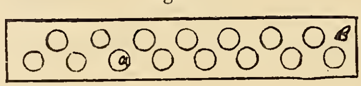


Fig. 273.

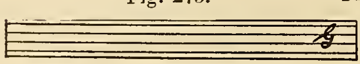


Fig. 276.

The perforated bed B, is secured to the top of a supporting-beam K, in combination with a yielding cross-head G, and a series of pins c, projecting downward from the under side.

Each perforation a in the bed B is directly under a corresponding pin in the cross-head. A shaft H, is arranged in bearings at or near the centre, and near the bottom of the framework, and on each end of this shaft is a balance-wheel I, outside of the legs b,

Fig. 274.

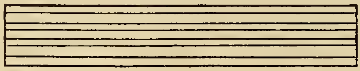
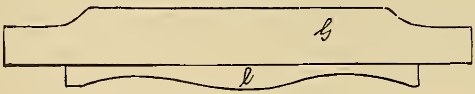


Fig. 277.

Fig. 275.



and on the same shaft inside of and near one leg is a pulley A, to receive the belt which drives the machine. Projecting outward from each of the wheels I, are crank-pins or wrist-pins i, and the lower end of a pitman k, connects with each pin i. The upper end of each pitman connects with the lower end of a vertical rod m, which passes freely through a hole in the beam K, and extends upward through the cross-head G. These rods m are screw-threaded from their upper ends downward to a little below the cross-head G, and the latter is connected with the rods m by nuts d beneath the cross-head, and by similar nuts e above. The nuts d are for raising or lowering the cross-head to any desired point of adjustment, and the nuts e are to screw down or up, and increase, release, or diminish the action of the springs g, which are arranged between the nuts e and the upper side of the cross-head G, so as to allow the latter to yield when the leather is placed on the perforated bed, beneath the cross-head and the pins c, the downward motion of which brings the lower ends of the pins into contact with the leather, pressing, forcing, or bending certain portions of the leather, and in succession other portions, across the edges of the perforation a, thereby limbering and softening the leather to the desired degree, or in proportion to the time the leather is moved about between the perforated bed and the pins and cross-head while in motion or action.

Instead of perforated bed and the pins, there are sometimes used a grooved bed and a grooved cross-head, shown in Figs. 273, 274, 276, and 277, and either straight or corrugated or serpentine horizontally, as in Fig. 275, but the perforated bed and the pins for softening most kinds of leather and hides are preferable, as they require less power, and have a tendency to enlarge the side or piece of leather or hide, by the peculiar operation of the pins and perforations drawing in every direction; whereas, in all previous modes of softening leather such as pounding the leather with a wooden mallet, when spread out on the tops of several pins promiscuously disposed, the leather was considerably contracted or reduced in size, and very imperfectly and unequally softened.

This machine is driven by a belt from some rotating pulley on to the pulley *A*, which rotates the shaft *H* and wheels or cranks *I*, through the medium of which, and the pitmen *k* and rods *m*, the cross-head *G* and pins *c* are moved up and down about two hundred strokes per minute. The leather or the hide is moved or fed along over the bed *B*, while the pins *c* strike or press portions of the leather into the perforations; changing from one portion to another until the whole surface of the leather has been acted upon, and the entire side or piece of leather is well and perfectly softened.

CHAPTER XXXV.

HORSE LEATHER FOR FOOT WEAR.

THE manufacture of horse hides for foot wear originated in Denmark, and from there it followed the coast of the Iberian peninsulas, and was largely developed in Hamburgh. There it took root immediately and was developed gradually to the highest degree of perfection.

From Hamburgh the art spread to Austria, Poland, the

Russo-German provinces and Scandinavia, which have each manufactured some very handsome horse-leather footwear.

England and France are also manufacturing this leather to some extent; but in the United States there is but little done in this line of manufacture. At the Philadelphia Exhibition in 1876 all other kinds of leather produced in this country were exhibited; horse leather being the only exception.

The beam-house work is about the same for horse hides as for other hides.

The lime work is reduced as much as possible, and it is desirable to use only fresh and pure lime baths, so that the sides may swell as much as possible and be apt to produce leather.

After having been properly limed the sides are unhaired on a well conditioned beam, wide and smooth. Sometimes two or three fleshed hides are spread upon the beam to bring them to the proper condition. The sides are next placed in clear water overnight, and are then green shaved and placed in a bate of hen manure, in which they usually remain for about four days, but this varies with the nature of the hide. The bating can be reduced to six or eight hours by using the England wheel shown in Fig. 112.

The bate is then worked out by hand, and it is desirable to work the thin places very cautiously; but at the same time the grain should be well cleansed. The sides after being allowed to remain overnight in clear water after the bate has been worked out, are then placed in the handlers and hung on sticks. The usual time which the sides remain in the handling liquors is six or seven days, and they are then laid-away twice in ground bark, both lay-aways extending through about seven weeks.

Upon being removed from the second lay-away the sides are hung on poles and exposed to the open air to harden, and are then dampened and split; but the operation of splitting horse-hides by machinery is much more difficult than that for other species of hides, and requires considerable experience.

In Hamburgh, Germany, where a large quantity of horse leather is manufactured, the splitting machine is not employed, the custom being to soak, unhair, and flesh the hides, and then

to cut the butt at once by taking off a few thicknesses with the fleshing knife.

The sides split by the splitting machine are next flattened by having their shanks and bellies levelled off with a currier's knife.

From this point the process of tanning and currying horse-leather is the same as has been described for the side of upper-leather in Chapter XXIX.

CHAPTER XXXVI.

RUSSIA LEATHER—THE MANUFACTURE OF RUSSIA LEATHER—RUSSIAN METHOD OF PREPARING AND APPLYING THE MORDANT AND DYE—MANUFACTURE OF BIRCH OIL—ARTIFICIAL RUSSIA LEATHER.

Section I. The Manufacture of Russia Leather.

Russia leather is employed more for articles of luxury than of utility, it possesses an agreeable odor, and does not moulder under the influence of dampness, nor is it liable to be destroyed by insects, which often ravage other leathers, the empyreumatic oil used in dressing it being a preventive.

But, as has been stated on page 67, its use for book-binding in the numerous public libraries of this country is being rapidly superseded by red-colored Morocco leather, which is attractive, more durable, and less costly.

Russia leather is much used in the manufacture of pocket-books, jewelry cases, handkerchief cases, and other toilet articles, also for albums, cigar cases, travelling bags, etc.

It derives its name from the country whence it originated, and where it is more especially manufactured; the method of which has only of late extended across the border of the Russian empire.

The Centennial Exhibition at Philadelphia in 1876 did not contain a single exhibit of this leather by a Russian manufacturer. Russia, at the Paris Exhibition of 1878, had only one manufacturer displaying samples of this specialty, M. T. Savine, who obtained a gold medal.

T. P. Howell & Co., of Newark, N. J., were the only manufacturers in the United States who exhibited Russia leather at the Centennial Exhibition.

The method of manufacturing this leather we shall describe as it is conducted in the United States, for the reason that the machines here employed are so much superior to those used in Russia that an article almost equal to the native Russia leather is produced, and in a much shorter time.

The hides used in the production of this leather are generally cow or steer hides, and large calf-skins, seldom goat or sheep-skins.

In tanning, the first operations, such as soaking, unhairing, fleshing, etc., are conducted in the same manner as for other kinds of leather.

The swelling of the hide is one of the essential points for its successful manufacture, and is proceeded with in the following manner: For one hundred cow or steer hides take twenty-two pounds of rye flour and ten pounds of oat flour, and knead with yeast and a little salt.

Allow this dough to ferment, and then thin with sufficient water to immerse the one hundred hides, which are left in this preparation for forty-eight hours, and when they are sufficiently swollen, the hides are placed in a tepid solution of willow and poplar barks. The hides are handled in this solution, twice a day, for at least eight days. They are next immersed in a liquor, the tanning ingredients of which are composed equally of oak, pine, and willow barks, and in this liquor they must also be handled at least twice a day. After eight days the last-named liquor is renewed and the hides are hardened and split, and then again placed in the liquor for another eight days, care being observed to handle as before. After this time the hides are sufficiently tanned.

The period of tanning can be considerably shortened by using a revolving-wheel, placed over the tan-vat to gently agitate the liquor, such as the England wheel shown in Fig. 112.

After being tanned the hides are cut into sides, and scoured and then rinsed in clean water and allowed to drip and dry. The sides are then slightly dampened and allowed to temper for two days and then greased with a mixture of birch oil and seal oil, two-thirds of the first and one-third of the second, according to the thickness of the leather.

For heavy leather a coat of this grease is applied to the grain side. The leather is then thoroughly greased on the flesh side, and afterwards fulled. The leather is next set out, then whitened, and finally boarded, and when well dried it is prepared for dyeing.

Before dyeing, the sides are submitted to an albuminous solution, which acts as a mordant to make the color penetrate more easily.

The leather is dyed black or red, but the latter color is most used.

The dye is made of a decoction of sandal wood, the quantity of which must be judged by the operator, who obtains the correct shade by repeated essays on small fragments of leather.

Sandal wood and cochineal give a richer color, and are sometimes used.

The leather must be dyed in several coats, taking care that the preceding one is well dried before applying another coat, the dye being applied with a brush to the grain side.

After dyeing, the leather is again impregnated with a mixture of birch oil and seal oil, which must be made to penetrate as much as possible, by rubbing energetically with a flannel rag on the grain side.

As a mordant in Russia they use chloride of tin prepared in the following manner: Take $5\frac{2}{3}$ ounces of azotic acid, heat it very slowly under a chimney having a good draft so as not to be indisposed by the emanations of the acid, pour in this hot solution, stirring it meanwhile with a glass or a wooden stick, 1 pound and 2 ounces of salt of tin. This operation must be done in the open air or under the influence of a strong draft, so

as not to inhale the deleterious vapors of the azote, which are excessively dangerous.

Stirring must be continued with caution so as to allow the unwholesome vapors to escape; when the mixture begins to whiten add $4\frac{1}{2}$ ounces of smoking hydrochloric acid, stirring carefully for a few moments.

The liquor must be cooled and put in hermetically closed bottles, to be kept in a cool place, and before using this liquor it must be diluted in a volume of from 12 to 15 times its own weight of pure water.

The leather being prepared and cleansed from all foreign substances, the mordant is applied very briskly and uniformly with a brush.

As coloring matter in Russia they use 1 pound and 2 ounces of sandal wood boiled for an hour in $1\frac{5}{8}$ gallons of pure water. This liquor is filtered and 1 ounce of prepared tartar and soda dissolved in it.

This mixture is boiled for an hour, and it is left standing for a few days before using it, as it is then stronger.

The sides destined for black dyeing are only oiled on the flesh side, which must be dried with a woolen rag, leaving the grain half-moist, and irreproachably neat.

The leather is submitted two or three times to the mordant, according to its thickness, and then dyed as many times with the warm dye, the temperature of which must be raised if necessary; *i. e.*, the dye must only be applied while warm, and if the operation takes too much time according to the number of skins, the dye must be kept at the proper temperature.

The application of the mordant and dye is done with a brush by rapidly spreading the liquid which is poured on the leather.

Rapidity in this operation is necessary in order to spread the dye equally on the whole surface of the leather and to insure the same shade on all its parts.

The first coat of color is applied immediately after the mordant and while the leather still retains some of its moisture;

in this manner the dye takes more easily and there is less risk of shading.

It is desirable for the good execution of this work to have two men operating together; the first applying the mordant, and the second the color immediately afterward. Should the color not be uniform another coat is applied at once with a lighter solution.

This red color lasts as long as the leather itself and does not damage it, whatever may be the time of its stay in the warehouse.

After the dye the leather must be slightly moistened on the flesh side with some tan juice and dried, and then grained.

The red Russia leather acquires a brilliant appearance when its colored side has been coated with gum tragacanth solution by means of a sponge; this gelatinous water must neither be too thick nor be applied in too large a quantity.

For graining the hides the same methods are followed as for the manufacture of Morocco leather; but instead of being "straight grained" or "pebbled" the finish is a diamond-shaped grain.

A new graining machine, especially for Russia leather, was lately invented by Towein, who, unfortunately, died when he was finishing it.

However, his work survives him, and his graining machine is in use in large French establishments and its success is complete.

Black colored Russia leather is prepared in the same manner as has been described, but is stained by the application of acetate of iron, aniline and other blacks being also used.

For a method of dyeing Russia leather with aniline colors, see Chapter XLIII., Section VIII.

Section II. Manufacture of Birch Oil.

This oil is commonly called Russia oil, but, notwithstanding this name, the bark of the birch tree of all countries will produce it, and it is in the whitish, membranous epidermis of the

bark that the oil exists, and this should be carefully separated from the ligneous or woody matter.

The bark is considered preferable when it has been freshly gathered.

If the distillation of the oil is done in the spring, some birch buds are mixed with the bark; a more limpid oil is thus obtained and its odor is more penetrating and delicate, as it resembles a little the flavor of the rose. This mixture also facilitates the separation of the oil, which when thus prepared is of a lighter color, from the small quantity of soot it contains.

Many systems are followed to distill the birch oil; some of them, very simple, are within the capabilities of any one; the others, more elaborate, require the science and complicated stills of the chemist. This oil can be readily obtained by distilling the bark in iron cylinders placed horizontally in a furnace.

In each of the methods of distillation, to be hereafter described separate the birch oil from the tar, acid, etc., underlying it, and keep it in a glass stoppered bottle or some other close vessel.

The following is a simple method for distilling this oil: Above any kind of receiver place an earthen pot of a convenient capacity with a hole pierced through its bottom; fill the pot with the bark, put fire to the bark, and cover the earthen vessel with another of similar capacity, also having a hole in its bottom. The bark burns slowly, the smoke and the heterogeneous products of this kind of distillation evaporate through the aperture in the upper vessel, and the oil runs through the lower opening into the receiver below.

Another method, which is that of Fischerstroern, is a little different from this, although based on the same principles. To carry it out, fill an iron caldron with bark and cover with a convex lid, in the middle of which a hole is made, for the introduction of an iron tube; above this caldron another one is placed and the two secured together, the second caldron having a hole in the bottom, through which passes the iron tube of the first caldron, but which must not touch its bottom.

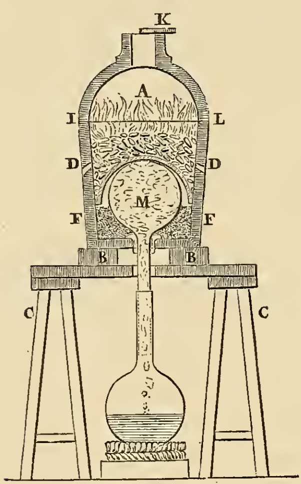
The two caldrons, suitably united, must be hermetically closed by means of clay. They are then inverted and half buried in

the ground, the one containing the bark being uppermost, and it is daubed over with a mixture of sand and clay. A large wood fire is built around this iron caldron, so as to bring it to a white heat. When everything is cooled the distillation is complete and the caldrons may be opened.

In the upper caldron there will be a fine coal powder, and in the other the products of the distillation, *i. e.*, the birch oil floating, underlaid with a little tar, upon a slight layer of pyroligneous acid.

By Grouvelle and Duval-Duval's process, the material is introduced into a copper still, similar to those used to distill wood in the manufacture of acetic acid. The receiver is so adapted as to be immersed in water in which the gaseous products are condensed, and, as in the manufacture of acetic acid, the resulting products are pyroligneous acid, tar in larger quantity, and the oil more colored, and less abundant.

Fig. 278.



The oil may be obtained nearly colorless by rectification, but this is not useful, unless the oil is intended to be employed on delicately colored leather.

By repeating the distillation *per descensum*, Payen ascertained that with a simple apparatus it is possible to obtain an oil less colored and in the proportion of one-fifth more, at a temperature less elevated.

To construct this apparatus, which is shown in Fig. 278, a hole is made in the bottom of an earthen furnace *A*, large enough to receive the neck of a matrass *M*. The furnace is supported by two bricks placed upon the plank, which is also perforated so as to admit of the passage of the neck of the matrass, and which rests upon the trestles *C*, *C*. The matrass is filled to its utmost capacity with the epidermis of birch bark; it is inverted and passed through the furnace and the board.

Then the neck is luted and placed in the position seen in the figure, being supported by sand thrown into the bottom of the furnace as high as *F*, *F*, and in order to expose the matrass to a uniform heat, it is protected by inverting over it an earthen hemispherical vessel or crucible. Around this, burning coals are placed, and the fire is kept up through two lateral openings, *D*, *D*, the dome *I*, *K*, *L* being placed upon the furnace top. Condensed water first trickles from the mouth of the matrass into a vessel placed beneath, and this is succeeded by drops, and then by a constant stream of an amber colored oil. After a time this ceases, and it is necessary to apply heat lower down to the neck of the matrass, so as to cause the discharge of the last portions of all tarry matters which have condensed in it.

The products obtained by the distillation of one hundred parts are as follows:—

A brown oily matter, light fluid empyreumatic, soluble in ether	70.00
Thick dark brown tar containing a little oil	5.00
Water acidulated with pyroligneous acid	10.00
Light spongy charcoal	12.50
Gases	2.50
	100.00

Section III. Artificial Russia Leather.

Artificial leather has been usually made of textile fabric coated with vulcanized rubber, and has been known in the trade as "rubber cloth." Sometimes it is made of textile fabric coated with varnish, and bears the name of "enamelled cloth." It has also been made of paper-pulp coated with varnish, and is then known as "leatherette." The appearance of leather in all these cases is imparted to the artificial compound by giving it the grain of real leather. The article, however, when partly composed of vulcanized rubber, has an unpleasant odor when subjected to a high temperature. When made of paper-pulp and varnish it does not long retain the color given to it by dyeing. In all these artificial leathers the coating cracks and peels off during wear, and none of them are pliable like real leather. If a cut is made in the material, it is liable to split its

entire length. The appearance or odor of Russia leather has never heretofore been given fully to artificial leather.

The object of the present method, patented by E. M. Freely, is to obviate the defects in ordinary artificial leather by producing an article which will have the appearance and peculiar odor of Russia leather, which will be pliable, retain the outside coating and dye in ordinary wear, and not be liable to tear unless much strength be exerted in the effort. To accomplish this take the ordinary imitation leathers, which are well-known articles of commerce, and steep them in a solution made of fifty pounds of bark of oak, fifty pounds of bark of hemlock, fifty pounds of bark of sumac, one pound of bark of willow, and nine hundred gallons of water. While the material is yet damp smear on the outer or leather side a solution made of a large tablespoonful of Russian jachten extract dissolved in a pint of alcohol and half a pint of ether. This, it is claimed, renders the material pliable and gives it the odor of Russia leather. It is then rolled up into bundles with the outer or leather side in and laid away to dry. When it has thoroughly dried, it is ready for use.

CHAPTER XXXVII.

ALLIGATOR LEATHER.

At present, the most fashionable material for small valises, satchels, portmonnaies, cigar cases, etc., is the skin of the American alligator, and in addition to uses enumerated it is also used for uppers of ladies' and gentlemen's shoes.

In all the Gulf States, from Florida to Texas, these sauroid fish are hunted to supply the demand.

Alligator leather has been in vogue for a long time; but during the past five years the slaughter of the alligator has been prosecuted with great activity.

These skins are usually packed for shipment in barrels and are green salted. The salting is usually poorly done, and if the

skins are allowed to remain too long in the barrels they become heated and the grain sides thereby become so injured that the skins have to be finished into second class leather.

Only the skin from the belly and sides is used, the back with its heavy coat of scales is cut out and thrown away as worthless.

All the skins show great uniformity, being of a bluish black hue on the sides and a peculiar bluish white under the belly, and each skin is curiously checkered in oblong divisions, which being separated by intersecting grooves, and wrinkled, give the peculiar appearance seen in all alligator leather.

The trade in these skins receive them of all sizes from three feet up, the average prices paid at New Orleans, La., for these skins ranging from fifteen cents each for the smallest to about one dollar for the largest. The skins most in demand are about seven feet long.

The skins of the monster alligators ranging from ten to fifteen feet long are not much desired. Under the continual destruction of alligators the supply is rapidly diminishing, and it is now but a question of a few years when it will be impossible to obtain these skins at a price that will justify their general employment.

To supply the demand for cheap articles, imitation alligator leather is now being largely produced.

The alligator leather of this country and the kangaroo leather of Australia are similar in the respect that they both depend upon wild animals to supply the material for their manufacture, and the business is therefore to some extent precarious.

At the place of shipment the skins from young, middle-aged, and old alligators are thrown promiscuously into barrels, and the first step when the skins arrive at the tannery is to assort the small and medium sized from the larger ones, which are kept separate.

The skins are then thrown into vats containing clear, cold water, and in these soaks the smaller skins remain about two days and the large ones four days.

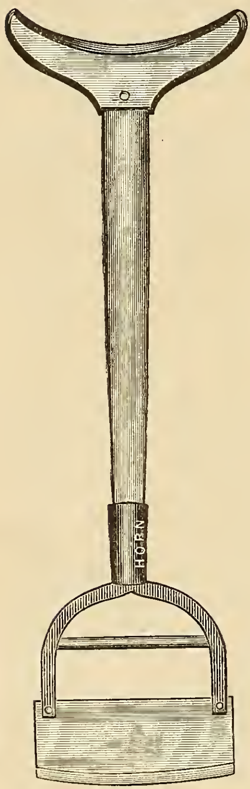
They next go into vats of lime, which should not be so strong as for depilating hides or skins, and in the limes they remain from eight to fourteen days, according to the size of the skins.

Each day the skins are reeled into stronger lime, great care being observed not to rot the tender portion of the skins during this swelling.

The bate of hen manure, into which the skins next pass, is made quite weak, and in this bate the skins are gently agitated by means of the usual England wheel shown in Fig. 112, the period for which they remain being from ten to fifteen hours, according to the size of the skins.

They are next cleansed in a wash wheel, and then thrown into a vat containing hemlock liquor of about 4° strength, and every other day the skins are shifted into stronger liquor until at the end of about twenty days it has been increased to about 20° strength.

Fig. 279.



A gentle agitation of the tanning liquor during the last twelve days is very beneficial, as it aids in the more thorough tanning of the skins, and prevents the settlement of the sediment of the liquor into the creases of the skins, which is liable to rot the tender portions, especially those of young alligators.

After being subjected to the tanning process just described, the skins are hung in the open air to harden.

They are then carried into the finishing room, and eight or ten skins are piled one upon the top of another and placed in a clamp, the flesh side of the skins being uppermost.

The flesh sides are then softened by the operator with a tool similar to that shown in Fig. 279, the object being to throw up the rougher portions, which are then lightly cut off with a currier's knife.

If the skins are intended to be manufactured into upper-leather, they are again placed in the tanning liquor of 8° or 10° strength,

and in this they remain for six or eight days, during which period they are gently agitated.

After being removed from the final tanning liquor the skins are scoured by hand on a slate table, first on the flesh and next on the grain side, the tools used being the scouring brush, stone, and slicker.

After being scoured the skins are placed in the air to harden, and when not quite dry they are carried into the shop and stuffed by hand, tallow, fish oil, and a small quantity of rosin being used.

They are next "set out," and are then carried to the finishing-room and blackened on the grain side with a preparation of log-wood and copperas.

They are next glassed by hand, and if a gloss is desired they are "pasted over the black" and hung up in the finishing room to dry over night.

In the morning the skins are re-glassed, and immediately finished by gumming them over on the grain side with a preparation of gum tragacanth, and are then measured and ready for market.

The skins not intended for the manufacture of upper-leather are not blacked, but are finished in their natural color, which is a yellowish-brown, and are used for satchels, pocket-books, etc.

A method for manufacturing Japanned leather in imitation of alligator skin is described in the following chapter.

CHAPTER XXXVIII.

PATENT, JAPANNED, OR ENAMELLED LEATHER.

The hides used for the manufacture of patent, japanned, or enamelled leather are the heaviest, largest, and finest slaughter hides that can be obtained; those from the "Blue Grass Region" of Kentucky are most esteemed for this variety of leather.

The material employed for tanning the hides is usually a

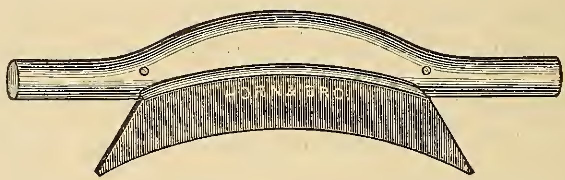
mixture of oak and hemlock bark, making what is known as union tannage.

The soaking, liming, unhairing, fleshing, and bating are the same as have been described for the other varieties of leather. The unhairing and fleshing are accomplished by hand, and the England vat and wheel shown in Fig. 112 is used for agitating the hides while in the bate of hen manure, and thus hastening the operation.

After the hides have been properly bated a different method is then employed for "working out the bate" from that which has been heretofore explained.

Upon removal from the bate the hides are worked in a hide-mill through which passes a stream of water. The hides are then laid upon a beam and carefully worked over with a bate stone, shown in Fig. 280.

Fig. 280.



When the hides have been properly worked with the bate stone, they are placed in a wash wheel and worked for about twenty minutes, after which they are in condition to go into the "handlers" to be properly swelled for the reception of the tanning liquor.

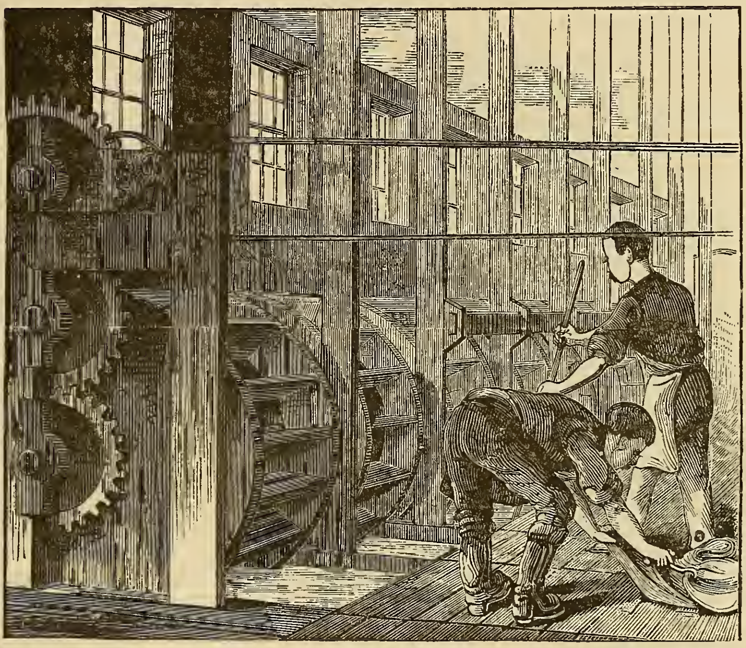
The hides are not laid away in ground bark, as has been described for sole and upper leather; but are placed in vats having a circular bottom, and above which there is placed a revolving wheel which agitates both the tanning liquor and the hides; there are usually a number of these vats in a line, as shown in Fig. 281.

The wheels are worked for about fifteen minutes each hour, and when about one-third tanned the hides are removed from the tanning liquor and a buffing is taken off of each hide, which

is sometimes done with a currier's knife and at other times with a splitting machine.

After the buffing has been removed from the hide it is next split by a large belt-knife splitting-machine, shown in Figs. 132

Fig. 281.



to 135, and is divided into three parts. The grain side is enamelled in various colors, and is used for carriage tops and upholstering. The middle is finished for splatter-boards and other trimmings for carriages, and also for harness use, and the flesh split is used in shoe manufacturing and for other purposes.

The split portions are next placed in a drum and strong gambier liquor poured over them, and in this wheel they are worked for about ten or fifteen minutes, the gambier liquor and working being to prevent the "glazing or crusting" of the partially tanned leather after it is replaced in the tanning liquor. After being fully tanned the leather is placed upon a table as shown in Fig. 137, and scoured, or the scouring may be done by

machinery, the Lockwood and improved Fitzhenry machines, which have been explained in Chapter XXI., being sometimes employed on this variety of leather.

The hides are next stretched after being scoured, and a good frame for stretching leather is shown in Figs. 282 to 286, and it is the invention of Charles P. Oliver and Theodore P. Howell, of Newark, N. J.

This device possesses the merit of unusual simplicity and cheapness of construction, and also is susceptible of operation without removing the frame from its pendent position from the supporting-bars.

Fig. 282 is a representation of a top view of Oliver and Howell's Machine. Fig. 283 is a vertical transverse section of the same. Figs. 284, 285, and 286 are details of the same.

Fig. 282.

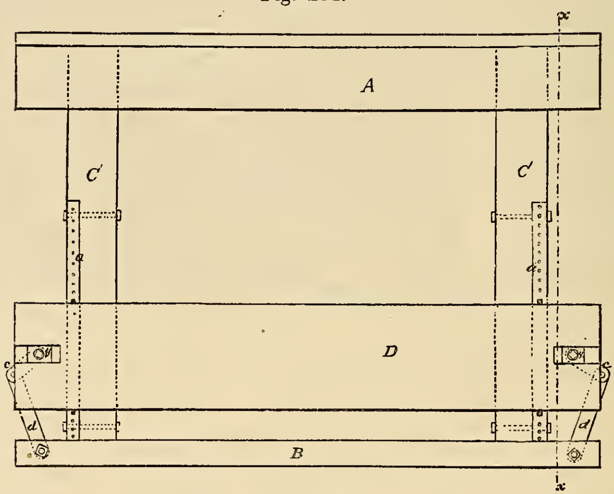
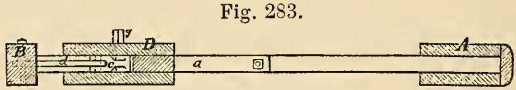


Fig. 283.



A represents the upper and *B* the lower cross-bar of the stretching-frame, and *C* indicates the sides. On the front sides of the bar *C*, or upon the sides of such bars, are affixed perforated plates, marked *a*. These perforated plates are adapted

for use upon wooden upright bars; but in case such bars be made of metal, the plates may be dispensed with, and the cross-bars themselves be perforated. The cross-bar A is constructed with a rounded upper surface, to adapt it for holding the centre of

Fig. 284.

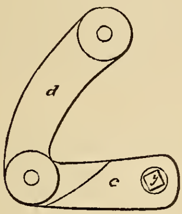


Fig. 285.

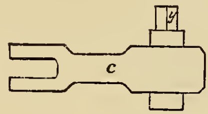
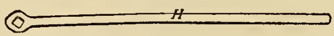


Fig. 286.



the hide, inasmuch as this apparatus is designed for attaching both flanks or sides of the hide to the sliding bar D. The letter D represents the sliding or stretching bar, which is arranged with reference to the bars A and C in the manner shown. The letter c indicates the short arm of a joint attached to the sliding bar D, and f indicates the long arm thereof attached to the bar B, each connection being made with a suitable pivot-pin or hinge. These two arms of the joint are united by a tongue-and-groove joint, as shown on Fig. 283. It will be observed that the end of the sliding bar D is slotted to provide for holding the forearm of the joint and allow the movements thereof. The letter y indicates a quadrangular wrist firmly attached to the short arm of the joint. It is preferable to cast this arm and wrist in one piece of metal. The letter H represents a wrench, the head of which is adapted to fit upon the wrist y.

To operate this device, tack the moist hide to the sides of bar D, allowing the centre thereof to rest upon the oval upper surface of bar A, and place the wrench head upon the wrist y. Then turn the wrench downward, bringing the two arms of the joint toward or beyond a right angle, thereby increasing the distance between the bars A and D. When the skin is sufficiently stretched, place a pin above the bar D in one of the

apertures of the perforated plate, and permit the skin to dry, or be manipulated, as the operator may see fit.

The hides are allowed to become perfectly dry on the frames before applying the compositions which are to finish the patent japanned or enamelled leather. The first operation consists in treating the hide to a mixture which is intended to close as much as possible the pores of the leather and thus obtain a ground ready to receive the varnish. The ground-laying mixture may be composed as follows:—

White lead	10 pounds.
Litharge	10 pounds.
Linseed oil	14 gallons.

These materials are boiled together until they are reduced to the consistence of a syrup, and then there is added chalk or ochre, according to circumstances, and the material is then spread upon the hide with a steel tool called a "railike."

The frame containing the hide is then placed in the driers with the face side downward as shown in Fig. 287. The driers have coils of steam-pipes arranged on the bottom and around the sides, through which there is a constant circulation of steam when all the racks are filled with frames containing the prepared hides. The steam to each drier is controlled by a suitable valve, and when it is desired to admit the heat to the drier, the door is placed to the larger front opening, and the valve opened so as to give a temperature of about 80° F. to the interior of the drier, and from this point the heat is gradually increased to 160° F., which is about the greatest heat that the fibres of the leather will stand without injury. Sometimes it is desirable to subject the leather to a greater heat than 160°, and in that case the fibres are protected by saturating the leather with a solution composed of:—

Alum	2 oz.
Borax	2 oz.
Water	1 gallon.

The leather is immersed in the above compound for about two hours, and when nearly dry it is stretched in the usual

manner on frames, and after japanning, it is placed in the oven as has been described, and the heat can then be gradually increased from about 80° to 230° or 250° F.

The borax may be dispensed with if desired, as it is not absolutely necessary to produce the effect; but is used to prevent re-crystallization of the alum. The leather is kept in the driers from six to ten hours, or until the composition is completely matured and the surface perfectly dry.

The ground is next rubbed with pumice stone to keep the surface smooth, and is then coated with from three to five layers of linseed oil colored with ivory black, and containing sufficient spirits of turpentine to enable it to flow evenly over the surface. After each application the hide is dried as has been described,

Fig. 287.

and it is after each application except the last one rubbed over with fine tripoli or pumice stone, applied with a piece of flannel.

A varnish is also used which is composed as follows:—

Spirits of turpentine	10 lbs.
Thick copal varnish	5 "
Asphaltum	$\frac{1}{2}$ lb.
Linseed oil	10 lbs.

The asphaltum can be replaced by an equal quantity of Prussian blue, or ivory-black, according to the finish desired, the one giving a reddish, and the other a blackish tint.

The varnish is allowed to remain in the finishing room for fifteen or twenty days before being applied to the surface and is laid on with a brush as shown in Fig. 287, and the room in which the varnishing is conducted is kept dampened and free from dust, similar to a coach-finishing or varnishing room.

The variety of leather is not softened or boarded until it is japanned and been perfectly dried; but in 1871 Franklin S. Merrill, of Boston, Mass., patented a process for boarding the leather while it is wet, by which manner of boarding it is claimed that the japanning is not cracked.

Renewing the Surface of Japanned Leather.

In 1863 Wm. Hoey patented in England the following compound for renewing the surface of japanned leather: Two ounces of paraffine, or rock oil, or a mixture of both in any proportion, to which are added one-quarter of a drachm of oil of lavender, one-quarter of a drachm of citrionel essence, and one-half ounce of spirits of ammonia. The mixture is applied lightly to the surface of the leather.

Preparing the Cut Surface of Split Leather for Manufacturing Japanned or Enamelled Leather.

The common way of buffing the hide or preparing it for japanning or enamelling is either by shaving off the inequalities with a currying-knife, as explained on p. 586, or by taking of a light buffing with the regular splitting machine. This light buffing, when finished, is of little value, bringing from one to three dollars. The way japanned or enamelled leather is often treated is by applying all the coats of the composition to the leather after

being tanned, and when perfectly dry on the frames. The naphtha or turpentine in the composition is then absorbed by the dry leather, and it becomes dry and harsh; but by applying the first coat of the composition when the leather is wet and the pores are filled with tan-ooze, the naphtha or turpentine evaporates before the leather becomes dry, and is not absorbed by it, and the leather is left soft and flexible and more easily worked.

If a heavy buffing be taken off, it leaves the surface fibrous and coarse, and it is necessary to have a smooth surface to finish on—that is, to japan or enamel.

Stephen J. Patterson, of Bridgeport, Conn., in 1883 patented the following method for forming an artificial grain on the hide after it has been buffed or split with a regular splitting-machine.

This process of treatment applies equally well to light buffings or splits, but is especially adapted to heavy ones by largely increasing their value.

Patterson's improvement is as follows: When the split hide comes from the tan-liquor after the tanning operation is completed, it is slicked out on a table and a light coat of oil spread over the surface with a sponge or soft brush. Then it is tacked on a frame, and while still wet the fibre or nap of the freshly-cut surface is brushed down smooth in one direction with a flexible bristle brush (like a shoe-blacking brush, but larger), which simply gives direction to the fibre or nap; and then there is applied, while the hide is still wet, with the same brush or with a sponge, rubbing in the same direction, a coat of composition made from linseed oil boiled down to a jelly and reduced with naphtha or turpentine to the proper consistency. After this application repeat the brushing operation as before. The hide is now left to dry, and when dry the composition holds the fibre or nap in place, and the leather has a smooth surface to japan or enamel. When dry it is finished the same as other japanned or enamelled leather. The hide is not dubbed with a mixture of cod oil and tallow or other grease, as in the ordinary method of preparing heavy leather. For shoes and harness only a light coat of oil is applied as stated. It is buffed or split with the splitting-machine when about one-third tanned.

For treatment by this process, Mr. Patterson takes off a heavy

buffing with the largest size improved "Union Splitting-Machine," shown in Fig. 227, making a buffing about three-fourths the size of the hide. This is thick enough to japan for shoe-leather or similar purposes, and will bring from four to eight dollars when finished. The extra expense will not exceed one per cent. of the cost of the hide.

Japanned Leather in Imitation of Alligator Skin.

The object of this process, which was patented by Franklin S. Merritt, of Boston, Mass., in 1871, is to produce japanned leather in imitation of alligator skin.

The leather is prepared by the ordinary process of currying for patent or enamelled leather. Afterward it is coated with a composition of linseed oil boiled with driers, viz., litharge, burnt or raw umber, sugar of lead, sulphate of zinc, Prussian or Chinese blue, mixed with naphtha, benzine, spirits of turpentine, or camphine, with sufficient lamp or ivory-black to give it coloring.

Fig. 288.

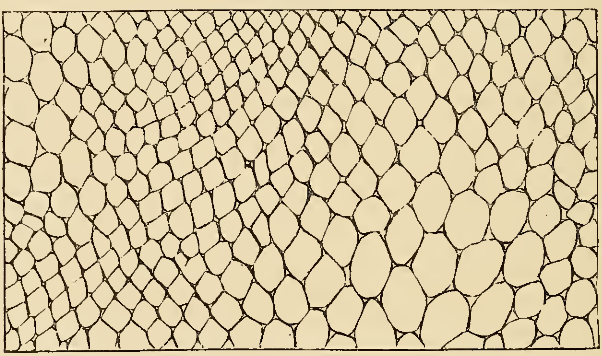
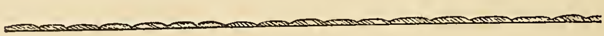


Fig. 289.



The leather, after being coated with several layers of the composition, each being dried before the next is applied, is rubbed with pumice-stone to give a smooth surface to the coating. Finally the last layer is applied and dried without rubbing

with pumice-stone, the whole making, thus far, what is usually called "patent or enamelled leather." The leather in this state is next wet sufficiently to soften it to admit of it receiving and retaining the impression of the die or rollers. Next the sheet of leather is passed between rollers or dies, or compressed by the same, so as to emboss it with the required figure or series of convexities. Next it should be softened while wet by "boarding," or by any other mode of effecting such as usually adopted by leather dressers and then dried.

Figure 288 represents a face view, and Figure 289 a section of a piece of leather made as described.

When finished it may be used for many purposes in the arts, particularly in the manufacture of hand-satchels, shoes, etc.

Substitute for Patent Leather.

It has been proposed to make a substitute for patent leather by applying to the surface of the usual split hides employed for patent leather thin sheets of zylonite or a similar substance of a proper color. The zylonite is applied to the leather by dissolving one side of the sheet in any of the well-known solvents and subjecting the same to pressure by passing the leather with the zylonite between a pair of rollers.

A solvent such as collodion is then applied to the exterior surface of the sheet of zylonite, and the leather is progressively passed between a pair of rollers or compressing surfaces in contact with a plate of glass until the zylonite will be as finely polished as the surface against which it has been compressed.

List of all Patents for Methods for Manufacturing Enamelled, Japanned, and Patent Leathers, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
12,226	Jan. 9, 1855.	H. L. Hall,	Beverly, Mass.
13,819	Nov. 20, 1855.	T. P. Howell and F. L. Blanchard,	Newark, N. J.
19,583	Mar. 9, 1858.	J. Rose,	Newark, N. J.
42,584	May 3, 1864.	F. Longhurst and A. L. Murdock,	Boston, Mass.
58,733	Oct. 9, 1866.	J. L. Newton,	Boston, Mass.
70,176	Oct. 29, 1867.	J. W. Dawson,	Newark, N. J.

No.	Date.	Inventor.	Residence.
114,586	May 9, 1871.	F. S. Merritt,	Boston, Mass.
115,083	May 23, 1871.		
282,664	Aug. 7, 1883.	S. J. Patterson,	Bridgeport, Conn.
289,241	Nov. 27, 1883.	J. B. Edson,	Adams, Mass.

List of all Patents for Apparatus for Stretching Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
22,893	Feb. 8, 1859.	A. W. Roberts,	Hartford, Conn.
28,271	May 15, 1860.	J. H. Haskell,	Baltimore, Md.
59,292	Oct. 30, 1866.	W. Strevell,	Jersey City, N. J.
66,131	June 25, 1867.	J. W. Danson,	Newark, N. J.
Reissues			
2,790	Oct. 29, 1867.		
2,791	Oct. 29, 1867.		
66,565	July 9, 1867.	V. Colvin,	Albany, N. Y.
67,431	Aug. 6, 1867.	T. P. Howell and C. P. Oliver,	Newark, N. J.
67,996	Aug. 20, 1867.	A. Marsh,	Newark, N. J.
69,327	Oct. 1, 1867.	W. Dunn,	Newark, N. J.
69,630	Oct. 8, 1867.	J. F. Coburn,	
69,633	Oct. 8, 1867.	J. F. Connelly and W. B. Hughes,	Newark, N. J.
77,615	May 5, 1868.	T. P. Howell and C. P. Oliver,	Newark, N. J.
82,063	Sept. 15, 1868.	W. R. Andrews and R. Dingwell,	Newark, N. J.
88,697	April 6, 1869.	H. Danson,	Baltimore, Md.
123,979	Feb. 17, 1872.	S. D. Castle,	Bridgeport, Conn.
Reissue			
6,252	Jan. 26, 1875.		
135,836	Feb. 11, 1873.	C. P. Oliver,	Newark, N. J.
154,073	Aug. 11, 1874.	C. P. Oliver,	Newark, N. J.
178,361	June 6, 1876.	W. Coupe,	South Attleborough, Mass.
184,352	Nov. 14, 1876.	J. N. Duffy,	Newark, N. J.
190,693	May 15, 1877.	J. Sharp,	Cincinnati, O.
207,508	Aug. 27, 1878.	H. N. Dodge,	Brooklyn, N. Y.
213,323	Mar. 18, 1879.	Wm. Coupe,	Attleborough, Mass.
215,640	May 20, 1879.	J. H. Leddy,	Newark, N. J.
240,095	April 12, 1881.	Wm. Coupe,	South Attleborough, Mass.
287,009	Oct. 23, 1883.	L. Dederick,	Newark, N. J.

PART VIII.

CHAPTER XXXIX.

TANNING PROCESSES.

A LARGE number of processes have been invented for facilitating the tanning of leather; but on account of various circumstances there are only a few that are of value to the tanners of this country.

Many of these processes have been patented by persons who are not practical tanners and who possess but a limited knowledge of the art in all its branches.

A good tanner must be able to judge the result of his work under various conditions.

It is often possible to save in the tanning of leather; but if care be not observed the loss in currying and finishing will greatly exceed the gain so made. The fact that a claimed improvement in tanning methods may have been invented by a person outside of the business should not, of course, weigh against it. MacBride was not a tanner, but to him we owe the discovery of the use of sulphuric acid for plumping hides, and the same might be said in relation to various other improvements.

Ninety-nine one-hundredths of all the leather produced in the United States is tanned by one of three methods: First, by placing the hides or sides in vats of ordinary construction with a layer of ground bark between the hides or sides and supplying fresh ground bark and tan-liquor thereto at stated periods; second, by placing the hides, sides, and skins in vats and agitating them gently by appliances that do not injure either the fibre or grain; third, by sewing the skins into bags

and forcing the tannin-liquor gently through the pores by pressure.

In America the cheapness of hemlock and oak bark, bark extracts and native sumach, makes it quite unnecessary to so largely employ imported tanning materials, as is the case in many portions of Europe.

All the above methods and materials for tanning leather have been enlarged upon in various portions of this work, and it now simply remains to give a synopsis of processes and materials not heretofore mentioned.

Tanning Processes.

A process consists of a series of acts performed in a definite and particular order in which each act or step co-operates with the other steps to produce a desired result. In tanning, these acts often consist in immersing the hide in different solutions. Where the substance of the invention consists in a single solution only, the patents will be found under the head of "tanning materials." Where no bark or other tannin-containing substance is used the patent will be found under "tawing," and where the novelty consists only in the apparatus or mechanical devices employed, look under the sub-class apparatus; for instance, if it is for facilitating the tanning process by agitating the hides and liquor in the vat, as by the England wheel, see list of patents for tan-vats, agitators, and handling appliances on page 358.

Snyder punctures the grain or flesh sides of hides at any time before or after they go into the tan-vats in order to facilitate the absorption of the tan-liquor.

German employs any alkali, neutral salt, or other material that will cause fermentation of the bark so as fully to extract the tannin and allow it to enter into combination with the hide without becoming crystallized.

Irving facilitates the absorption of the materials for liming and tanning hides by the application of electricity.

Hibbard, 1, depilates with lime and wood ashes; 2, employs a composition of salt, sulphuric acid, sumach, oak bark, or any other tannin mixed together in water. Acetate of lead is used

in the compound employed for tanning white and thin leathers for gloves, linings, binders, etc. This process is also claimed to be applicable to tanning goat-skins, for Morocco. The ingredients employed and the proportions in which they are used in this process will be found on page 559.

FULTON, after having bated the hides, 1, uses 2 to 3 pounds of muriate of ammonia and 7 to 10 pounds of nitre dissolved in sufficient water to cover the pack of 20 slaughter hides; 2, places the hides in weak bark-liquor for one day, or until a fine grain is formed; 3, places hides in strong liquor for from three to five days, until sufficiently plumped; 4, lays-away in bark and liquor.

ENOS, after the sole leather hides have been properly prepared, 1, steeps them in a solution composed of 40 pounds of Sicily sumach, or 150 pounds of underground native sumach, in 250 gallons of water, to which are added 25 pounds of salt. 2. The hides after remaining in the first compound, kept at a temperature of about blood heat, have the liquor strengthened by 200 gallons of strong oak or hemlock liquor and 15 pounds of salt, and the hides allowed to remain in the strengthened liquor for from twelve to twenty-four hours. 3. The hides are withdrawn from the above liquor and placed in the same quantity of strong, cold oak or hemlock liquor containing 20 pounds of salt in solution, and remain for five or six days. 4. The hides are removed from the cold liquor and placed in same quality and quantity of liquor, except that it is at about a temperature of about blood heat, and in which they remain for about five or six days. The last described operation is repeated for six or seven times, after which it is claimed that the sole leather will be tanned. While passing through the different stages the leather should of course be repeatedly handled.

KEELER introduces oil into the tanning-liquor and facilitates its incorporation with the leather, agitating the liquor and leather with the England wheel shown in Fig. 112.

WATTLES. 1. Depilates with soap combined with salt and lime. 2. Combines soap with the tan-liquor.

GOULD. 1. Uses a combined solution of catechu and saltpetre. 2. Employs a combined solution of catechu and alum. Other

tannin containing materials may be employed in place of catechu.

HATCH. 1. Bates the hides in the usual way until the lime is thoroughly worked out. 2. Rinses in clean water. 3. Hangs up in a tight smoke-room, butt and neck, grain side out, and smokes in such a manner that the hides do not become heated, upper and collar leather being smoked six hours, other varieties according to the thickness of the hides. 4. Takes them out and soaks one hour in clean water. 5. Puts the hides in tan-ooze of moderate strength, and stirs and handles until the grain is evenly struck through. 6. Increases the strength of the liquor from day to day, and handles until the hides are tanned.

To obtain a light color in the terra japonica or hemlock-ooze, adds a little sumach in the first handler in such proportions as ½ pound per side for upper leather. For heavy leathers, such as harness and sole leather, after being prepared in the usual way it is smoked six hours, then soaked in clear water one hour, then smoked again six hours, and soaked, and put into tan as above described.

DANIELS. For 20 cowhides: 1. Steeps them, after they have been properly prepared in the beam-house, for one day in 15 pounds of catechu dissolved in sufficient water to cover the hides. 2. Takes out the hides and adds 15 pounds of catechu and 4 ounces of nitre or saltpetre, and in this liquor the hides are replaced and remain from three to five days according to thickness. 3. Prepares another liquor by dissolving 15 pounds of catechu in sufficient water to cover the hides and adds thereto 1½ pounds sulphuric acid, which is thoroughly mixed, and in this they remain one day, when it is claimed that they will be tanned. In a later patent, Daniels combines the use of cream of tartar and bicarbonate of soda in making the liquor and using it for tanning.

KENNEDY makes a composition of 24 pounds of valonia or divi-divi, 8 pounds sulphate of soda, 4 pounds of sulphate of magnesia, or sulphate of potash, 1 pound of sulphate of alumina, 2 pounds of sal-soda (carbonate of soda), 1 pound borax or boracic acid, the ingredients being dissolved separately in hot water or hot decoction of tan-bark, which is preferable. The

compound is then poured into a tank and thoroughly stirred to form the tanning-liquor, which may be drawn off as desired. The tanning-liquor thus formed is the most concentrated form, and only suitable to be applied to hides in the advance stages of tanning, and must be largely diluted with water or bark-water before it is applied to hides at the commencement of the process, or else, before applying it to such hides, it should be partly spent by having had hides immersed in it that are in a more advanced state.

The liquor is increased in strength as tanning progresses, the hides being handled frequently at first, but less handling will answer as the process advances. Hides intended for sole leather may, near the close of the process, be laid away with layers of ground bark, and then a liquid compound of 3 parts of the composition before mentioned, and 1 part of strong bark liquor poured over them until the hides are covered, and they remain undisturbed for twelve or fifteen days until tanned. Light skins are tanned by simply handling in the liquor.

NOBLE. 100 calf-skins having been previously unhaired and bated, are: 1. Immersed in a preparation of 10 pounds of catechu dissolved in sufficient water to cover them, and kept in motion for two or three hours until well colored. 2. Then adds 10 pounds more of catechu, and allows the skins to remain for fifteen to twenty-four hours, handling occasionally. 3. Removes the skins, and adds to the liquor in the vat 15 pounds of catechu, 10 pounds of sulphate of soda, and 2 pounds common salt. 4. Immerses the skins in the liquor just prepared, and allows them to remain, with the addition of 10 pounds of catechu each day thereafter until tanned, which is usually from five to ten days. 5. Removes from the previous liquor and prepares a new liquor termed the "fixing bath," consisting of water sufficient to cover the skins, to which are added 1 ounce of commercial nitric acid and ½ ounce of glycerine to every 4 gallons of water. In this mixture the skins are placed and handled frequently for from ten to eighteen hours, or until they assume a bright, suitable color, which may be varied by the time of immersion to suit the fancy. 6. Rinses the skins so as to insure the removal of free acid, when they are dried, and, it is claimed, ready for the currier.

The skins during the whole process are handled daily and freely exposed to the air. Heavy hides require more time, but the same relative proportion of the ingredients and order of their use is observed.

GARGE. After the hides have been unhaired and bated, to tan 100 sides of sole or harness leather:

1. To 300 gallons of water adds 20 pounds sal-soda and 8 pounds common salt. Immerses the sides in the above liquor for forty-eight hours.

2. Places the sides in a liquor composed of 300 gallons of water, 60 pounds of catechu or terra japonica, and 8 pounds of common starch, and in this they remain for two days, the object being to set the grain.

3. Puts them in a liquor composed of 300 gallons of water, 80 pounds of terra japonica or catechu, 8 pounds of starch, and 6 pounds of saltpetre, and in this liquor the sides remain until struck through.

4. Places the sides in a liquor composed of 300 gallons water, 80 pounds catechu, 8 pounds starch, and 10 pounds of alum ; the sides remain in this liquor for about six days, or till entirely filled and sufficiently plumped to be solid and firm.

PAGE employs terra japonica or catechu, 3 parts; sulphate of alumina and potassa or alum, $\frac{3}{4}$ part; chloride of sodium, or common salt, 6 parts; nitrate of potassa or saltpetre, 1 part; sulphate of soda or Glauber's salts, 3 parts. These several ingredients are separately dissolved in hot water and thoroughly mixed together in a vat.

Water is then added in the proportion of $2\frac{1}{2}$ gallons to every pound of catechu when in a dry state.

After being prepared in the usual way for tanning, the hides or skins are immersed in this liquor and allowed to remain therein for about forty-eight hours. The strength of the liquor is then increased until it bears the proportion of only $1\frac{1}{2}$ gallons of water to each pound of dry catechu, and in this the hides are kept from eight to ten days, according to their relative size and thickness, in which time, it is claimed, they will be thoroughly tanned. 12 pounds of catechu and a proportionate quantity of

the other ingredients of this composition are sufficient to tan half a dozen calf skins, or an equivalent quantity of hides.

Robinson makes a terra japonica liquor, which we will call "No. 1," as follows: Puts 112 gallons of water in a suitable kettle heated over a fire, and adds 15 pounds of common terra japonica to it, and stirs until dissolved. Then adds 3 ounces of common sulphuric acid very cautiously, stirring the liquor rapidly. It is dangerous to pour strong sulphuric acid into hot water, therefore the sulphuric acid should be carefully poured in when the water is cold, or otherwise it should be greatly diluted. The acid precipitates the impurities contained in the catechu.

The clear liquor is next racked off from the cooling-tank into a vat (leaving the sediment behind), and is used as follows: For upper leather, add to the quantity of racked-off liquor, No. 1, described above, about $\frac{1}{4}$ ounce of dissolved carbonate or calcined magnesia and about $\frac{1}{16}$ ounce of sulphate of potassa, and then add as much water as will reduce liquor No. 1 to $\frac{1}{2}$ its strength, which will be sufficient for 10 good-sized hides. The whole is now stirred up and forms the tanning-liquor No. 2, and the hides are placed in this liquor and are moved frequently for the first two days.

Fresh clear liquor No. 1 must always be kept prepared to maintain the strength of the vat-liquor No. 2, in which the hides are being tanned. About 35 gallons of No. 1 liquor and 1 ounce of sulphate of magnesia are added every second day at the early stage of the process, the hides being lifted out to put in the new liquor.

The quantity of magnesia sulphate added to the liquor depends upon the amount of "plumping" which the hides require, which the practical tanner can judge by inspection. The No. 2 liquor is gradually increased towards the end of the process. At the completion of the tanning process the hides are lifted out of the liquor and treated the same as when tanned by the ordinary process.

About 100 skins or 50 calf-skins may be tanned in the same quantity of liquor as for the 10 hides above described. Harness and sole leather are made harder and more firm than upper leather; but the liquor for cow and ox-hides to produce them is made up

exactly like No. 2 described, and the process conducted in the same manner, with the exception that two ounces of sulphate of potassa are employed or added to the first liquor which the hide receives. This salt, it is claimed, renders the sole leather hard and firm. The time required to tan harness leather is from four to eight weeks, and from six weeks to three months for sole leather. In making up new vats old liquors are used in place of water when they can be obtained. This method does not quicken the process of tanning, but it is claimed that the leather is made more flexible and durable than leather tanned by the ordinary process.

Wyeth makes a soak of soft water, in which are dissolved 1 pound of caustic potash and 2 pounds of sal-soda, which is kept at a temperature of about 100° F., and in this the dry hides are softened. Then breaks flesh in the usual way and works out thoroughly. Next hangs in a suitable sweat-room which is kept at a temperature of about 60° F., and in this apartment the skins remain until the hair comes off easily. They are then unhaired in the usual manner and afterwards subjected to a thorough rinsing in fresh, cold water, and then worked on the beam.

The skins are next again suspended in the sweat-room, the temperature of which is still kept at about 60° F., and subjected to the steam or vapor which rises from the combustion of equal parts of wet spent tan-bark, damp horse-dung, and damp rotten wood; this vaporizing process being employed in place of bating the skins, and also to facilitate the tanning.

After being vaporized, the skins are again worked thoroughly and then subjected to a compound tan-liquor composed as follows: Steep 510 pounds of hemlock or chestnut-oak bark, 50 pounds of Sicily sumach, 25 pounds divi divi in a sufficient quantity of rain-water to receive 60 sides or 200 calf-skins. In this solution dissolve 5 pounds of alum. While the skins are in this liquor they must be handled frequently, and the strength of the first liquor kept up by the following compound: In a sufficient quantity of water dissolve 1 bale of japonica, 20 pounds Glauber's salts, and 14 pounds common salt, with which

strengthen the first tanning-liquor from time to time as required, handling the skins frequently till fully tanned.

PICKARD employs the essence of turpentine with sumach, catechu, or other vegetable or mineral coloring essence for tanning hides and skins.

WHEELOCK first soaks the hides or skins in a liquor made of fermented corn-meal, one pound; common salt, two pounds; soft water, eight gallons. In this liquor the hides or skins remain until they are soft, and are then placed in the unhairing liquor, which is composed as follows: soft water, eight gallons; carbonate of soda, one pound; lime, three pounds; leached lye, two quarts. In this liquor the hides or skins remain from two to four days, until the hair slips easily. Then the hair is removed and the hide put in a bating-liquor, which is made as follows: soft water, eight gallons; nitric acid, one-fourth pound; common salt, one pound; corn-meal, one-quart; hen-manure, two quarts. In this liquor the hides or skins remain from two to four days, until they are reduced to their natural thickness.

After the hides or skins have been removed from the bating-liquor place them in the tanning-liquor, which is made as follows: nitric acid, one pound; salts of ammonia, one-fourth pound; common salt, three pounds; fermented corn-meal, two quarts; catechu, three-fourths pound; sumach, one pound. In this liquor the hides or skins remain for three days (more or less), and then remove them into the second tanning-liquor, which is composed as follows: soft water, eight gallons; fermented corn-meal, three quarts; nitric acid, one-half pound; salt of ammonia, one-eighth pound; common salt, two pounds; catechu, one pound; sumach, one and one-half pound; carbonate of soda, one-fourth pound. In this liquor the hides or skins remain for six days; then they are washed and scoured with soft water, and after the water has been slicked out as much as possible the hides or skins are stuffed with the following compound: tallow, one pound; straits oil, one pint; castor oil, one-half pint; beeswax, two ounces; alcohol, one-fourth pint; corn-starch, one-half pound; to which may be added, for polish, white glue, two ounces, and sufficient lampblack to produce a good black.

The above quantities are sufficient for tanning one hide or four calf-skins.

Kidder's method. To tan 12 hides of upper leather according to this method, use a sufficient quantity of water to cover the hides. Then dissolve 25 pounds of japonica or gambir. Then add the solution to the water. Then compound 3 quarts of the solution of potash or pearlash (the solution to equal the strength of strong lye) and 1 pound of sulphate of zinc. Dissolve the zinc first in hot water. Then add the compound to the tanning-liquor. Then the liquor is ready for the hides. Place the hides in the tanning-liquor. Handle them up occasionally for two days. Then take them out and renew the liquor by adding 35 pounds of japonica or gambir, dissolved as before, and poured into the liquor. Then compound 3 quarts of the solution of potash or pearlash, 2 pounds of the sulphate of zinc, 2 pounds of sulphur. Dissolve the sulphate of zinc and sulphur in boiling water before compounding with the alkaline. When compounded, add to the tanning-liquor. Then place the hides in the liquor. Handle them up for 4 days; then take them out and renew the liquor by adding 40 pounds of japonica or gambir, dissolved as before, two quarts of the solution of pearlash or potash, 2 pounds of the sulphate of zinc, 3 pounds of sulphur, 1½ pound of sugar of lead, to be dissolved and compounded as before, then added to the tanning-liquor. Then place the hides in the liquor thus compounded, and handle them up occasionally for 5 days, which completes the tanning operation of the 12 hides.

Calf-skins, harness, and all other kinds of leather should be treated in quantities of ingredients and time proportionally.

To tan with bark, to each cord of bark use two gallons of the solution of potash or pearlash, 5 pounds of sulphate of zinc, 5 pounds of sulphur, and 1½ pound of sugar of lead. Before adding the above-named ingredients to the bark-liquor dissolve them in boiling water, then compound them and add them to the bark-liquor. For white-oak bark, double the quantities.

Jenkins, for the purpose of liming the raw hides, say forty, takes 1 bushel of lime and 1 pound of potash, upon which he puts sufficient water to cover the hides by the liquor thus made.

In this solution they must remain for from two to three days according to circumstances, after which they are removed to undergo the bating process in a solution compounded of 1 peck of stone lime and 4 pounds of sulphur by boiling such ingredients in water, enough of the latter being added to make the desired quantity of liquor. After a period of one day or one day and a half the hides are taken out of the bating solution and transferred to the tanning-vat, which contains the tanning compounds. The latter is prepared from the following ingredients:

Take 20 pounds terra japonica, 5 pounds of wood-acid, 5 pounds of hops, 10 pounds of best sumach, to about 10 barrels of water, or enough of the latter to cover the hides. It is desirable to subject the hides in the beginning of the tanning process to a solution somewhat weaker than the above will make. It is preferable to take only about two-thirds of the stated quantity of the ingredients above named to the required quantity of water, and add the remaining third as the operation progresses. After the hides have been in this liquor for about fifteen days, the tanning is claimed to be completed, and, after drying, the leather may be finished in any approved manner.

Ruemelin's Tan Vat.

In the process of tanning hides it is desirable to subject them to a weak liquor first, and gradually to increase the strength of the liquor until the process is completed. In practice, however, it is common to make the liquor of uniform strength, and apply it first at full strength to hides which have been so far advanced in the process as to require liquor of full strength. The liquor, in passing through one vat of hides, is reduced in strength thereby, when it is of the required strength for the next preceding vat. Ruemelin has therefore arranged the vats in a series as shown in Figs. 290 and 291, so that the liquor as it is reduced in strength will flow from the hides which are finished to those which have first been placed in the vats, so that by the time the liquor reaches the green hides, last introduced, it will become sufficiently reduced in strength as not to injure them. As the hides in the last vat are finished they are removed, and the hides in the next succeeding vat are moved forward into it,

and so on. All the hides in each vat are moved forward one vat at a time, from the first to the last vat in the series, every time a vat is emptied. Fig. 290 represents a vertical section, and 291 a top view of Ruemelin's tan vat. The hides are first

Fig. 290.

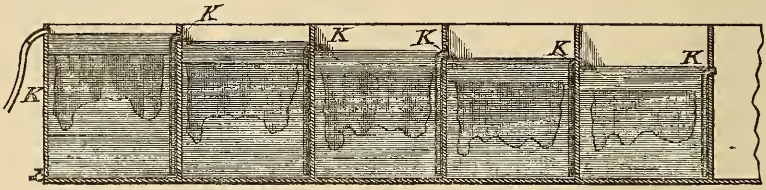
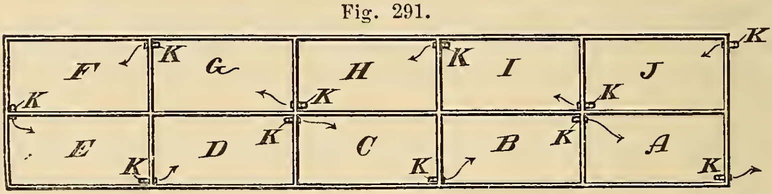


Fig. 291.



placed in vat *A*, and from thence moved forward to vats *B C D E F G H I J*. The liquid is first introduced into vat *J*, from whence it flows from one vat to another, as indicated by the arrows, until it reaches the vat *A*, the liquor being so reduced in strength by the time it reaches such vat *A* that it is adapted, as stated, to the condition of the hides in their fresh state. Each vat in the series is provided with a pipe, *K*, reaching from its bottom to near its top. The upper ends of the respective pipes project through a closely-fitting hole in the partition between the vats, thus forming a duct through which the liquor passes from one vat to another. As the mouths of the respective pipes extend to near the bottom of the vats, it is obvious that the liquor will rise in the pipe as the vats are filled, and when the liquor reaches the level of the passage through the partition it will commence to flow from the bottom of one vat to the top of the next. The passages through the partitions are formed successively lower from the first, *J*, to the last, *A*, so that as the liquor is admitted into the first vat it will gradually find its way to the last, and will, as stated, be caused to pass in at the top and out at the bottom of the respective vats in the series.

List of all Patents for Processes for Tanning Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
866	Aug. 1, 1838.	A. Hickman and E. L. Davenport,	Abingdon, Va.
1,018	Nov. 25, 1838.	T. Chase,	New York, N. Y.
1,160	May 30, 1839.	W. Herapath,	Bristol, Great Britain.
1,741	Aug. 25, 1840.	A. H. Buzzell,	Bridgetown, Me.
2,332	Nov. 10, 1841.	S. Guilford,	Lebanon, Pa.
2,706	July 8, 1842.	A. Van Pelt,	Bedminster, N. J.
3,614	July 5, 1844.	J. Cox,	Edinburgh, Great Britain.
3,639	July 24, 1844.	Kettering and Vogle,	Hempfield, Pa.
3,993	April 10, 1845.	S. Snyder,	Dayton, O.
4,615	July 2, 1846.	W. Germar,	Easton, Pa.
5,261	Aug. 28, 1847.	Dr. A. Turnbull,	London, England.
6,373	April 24, 1849.	E. Irving,	New York, N. Y.
6,790	Oct. 16, 1849.	H. Hibbard,	Henrietta, N. Y.
9,406	Nov. 16, 1852.	D. Kennedy,	Reading, Pa.
9,840	July 12, 1853.	J. J. Fulton,	Monongahela City, Pa.
11,325	July 18, 1854.	R. Enos,	Woodstock, Ill.
12,148	Jan. 2, 1855.	R. Keeler,	Rochester, N. Y.
13,443	Aug. 14, 1855.	O. B. Wattles,	Waddington, N. Y.
14,375	Mar. 4, 1856.	A. Steers,	Medina, N. Y.
14,399	Mar. 11, 1856.	R. Gould,	Whitewater, Wis.
15,157	June 17, 1856.	J. P. Williams,	Salem, Mass.
15,303	July 8, 1856.	S. W. Pingree,	Methuen, Mass.
15,736	Sept. 16, 1856.	G. W. Hatch,	Princeton, Ill.
15,896	Oct. 14, 1856.	S. W. Pingree,	Methuen, Mass.
16,189	Dec. 9, 1856.	O. Rich,	Cambridge, Mass.
16,355	Jan. 6, 1857.	E. Daniels,	Lafayette, Wis.
17,043	April 14, 1857.	D. H. Kennedy,	New Alexandria, Pa.
17,868	July 28, 1857.	J. Carle,	Kingston Township, Pa.
18,030	Aug. 18, 1857.	L. L. A. Elie de La Peyrouse,	Paris, France.
19,201	Jan. 26, 1858.	B. G. Noble,	Whitewater, Wis.
19,756	Mar. 30, 1858.	C. Daniels,	Elkhorn, Wis.
20,502	July 8, 1858.	J. Morgan,	Sumterville, S. C.
20,565	July 15, 1858.	H. G. Johnson,	Cleveland, O.
22,285	Dec. 14, 1858.	W. W. Garge,	Rochester, N. Y.
23,360	Mar. 29, 1859.	T. T. Fergusson,	New York, N. Y.
23,471	April 5, 1859.	H. Johnson,	Farmersville, N. Y.
24,278	June 7, 1859.	J. Brainerd and W. H. Burridge,	Cleveland, O.
25,045	Aug. 9, 1859.	J. B. Read,	Cold Spring, N. Y.

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No.	Date.	Inventor.	Residence.
25,241	Aug. 30, 1859.	J. Brainerd and W. H. Burridge,	Cleveland, O.
25,315	Sept. 6, 1859.	J. Brainerd and W. H. Burridge,	Cleveland, O.
25,522	Sept. 20, 1859.	T. S. Page,	Milan, O.
25,671	Oct. 4, 1859.	S. Pierce and F. E. Beardsley,	Castle Grove, Ia.
26,966	Jan. 31, 1860.	W. D. Bunting,	Cleveland, O.
27,088	Feb. 7, 1860.	P. Daniels,	New York, N. Y.
27,177	Feb. 14, 1860.	W. R. Webster,	New York, N. Y.
27,259	Feb. 21, 1860.	C. L. Robinson,	Waukesha, Wis.
27,338	Mar. 6, 1860.	D. Aldrich,	St. Louis, Mo.
27,823	April 10, 1860.	D. Needham,	Oskaloosa, Ia.
27,961	April 24, 1860.	M. A. Bell,	Rushford, N. Y.
29,140	July 17, 1860.	D. J. Cochran,	Centreville, Ind.
30,220	Oct. 2, 1860.	R. Harper,	Turnbull, O.
30,367	Oct. 9, 1860.	J. L. Wells,	St. Louis, Mo.
30,390	Oct. 16, 1860.	R. Crane, and W. Baldwin,	Anamosa, Ia.
30,392	Oct. 16, 1860.	A. Dietz,	New York, N. Y.
31,640	Mar. 5, 1861.	A. R. Wyette,	West Middletown, Pa.
32,526	June 11, 1861.	H. McKenzie,	Talladega, Ala.
33,183	Sept. 3, 1861.	J. Brainerd,	Cleveland, O.
34,005	Dec. 24, 1861.	D. Mumma,	Mt. Carroll, Ill.
34,192	Jan. 21, 1862.	M. Benas,	New York, N. Y.
34,688	Mar. 18, 1862.	J. J. Johnson,	Kalamazoo, Mich.
36,636	Oct. 14, 1862.	Z. Baker,	Erie, Ill.
42,619	May 3, 1864.	J. Burrill,	Lynn, Mass.
43,013	June 7, 1864.	W. Field and J. Townsend,	Wilmington, Del.
43,346	June 28, 1864.	H. Stratton, Jr.,	Leavenworth, Kan.
43,563	July 19, 1864.	J. S. Boothby,	Portland, Me.
48,740	July 11, 1865.	W. E. Terry,	Wyoming, Wis.
50,222	Oct. 3, 1865.	O. A. Coe,	Charleston, S. C.
50,936	Nov. 14, 1865.	J. J. Johnson,	Kalamazoo, Mich.
50,945	Nov. 14, 1865.	J. M. Muller,	North Becket, Mass.
51,762	Dec. 26, 1865.	W. H. Towers,	New York, N. Y.
52,464	Feb. 6, 1866.	B. F. Taber,	New York, N. Y.
52,655	Feb. 13, 1866.	B. Pickard,.	Paris, France.
53,688	April 3, 1866.	J. Schultz,	Ellenville, N. Y.
54,588	May 8, 1866.	M. W. Page,	Franklin, N. H.
56,643	Oct. 9, 1866.	G. W. Hernsey,	Greenbush, Wis.
57,275	Aug. 21, 1866.	G. Aymard,	New York, N. Y.
57,409	Aug. 21, 1866.	W. H. Towles,	New York, N. Y.
57,795	Sept. 4, 1866.	J. N. Sturtevant and H. E. Jones,	McGregor, Ia.
59,109	Oct. 23, 1866.	G. D. Wheelock,	Freedom, O.

No.	Date.	Inventor.	Residence.
60,006	Nov. 27, 1866.	A. Hill,	Dubuque, Ia.
60,108	Nov. 27, 1866.	J. Wood,	Woodstock, Vt.
60,472	Dec. 18, 1866.	J. W. Calef,	Sudbury, N. H.
60,701	Jan. 1, 1867.	J. Davis and J. McKelvy,	Pawtucket, R. I.
62,611	Mar. 5, 1867.	J. C. Coulton,	Buffalo, N. Y.
64,589	May 7, 1867.		Jersey Shore, Pa.
65,190	May 28, 1867.	O. B. Evans,	Buffalo, N. Y.
65,323	May 28, 1867.	F. H. Wright,	Richmond, Ind.
68,631	Sept. 10, 1867.	G. L. Loverside,	Burk Bank Cottages, Eng.
69,042	Sept. 17, 1867.		St. Louis, Mo.
69,636	Oct. 8, 1867.	C. J. Cushing, B. F. Walls, W. A. Wood,	Hancock County, Ky.
70,337	Oct. 29, 1867.	A. W. Irish,	Rochester, Minn.
76,015	Mar. 24, 1868.	C. J. Weston,	Cummington, Mass.
76,824	April 14, 1868.	B. Schmidt,	Hoboken, N. J.
76,957	April 21, 1868.	D. Symonds,	
78,256	May 26, 1868.	F. J. Burcham,	Racine, Wis.
78,672	June 9, 1868.	E. Keith,	Wabash, Ind.
80,693	Aug. 4, 1868.	W. Windoes,	Fond Du Lac, Wis.
81,237	Aug. 18, 1868.	J. Wood,	Woodstock, Vt.
82,517	Sept. 29, 1868.	B. F. Gross,	Trenton, Tenn.
82,763	Oct. 6, 1868.	G. A. Starkweather,	Waymart, Wis.
83,433	Oct. 27, 1868.	G. Tippe,	New York, N. Y.
84,169	Nov. 17, 1868.	C. J. Burgh,	Eau Claire, Wis.
85,327	Dec. 29, 1868.	C. O. Swani,	Tolentino, Italy.
87,325	Mar. 2, 1869.	J. F. Bechmann,	Abbott's Corners, N. Y.
87,894	Mar. 16, 1869.	C. A. Williams, Jr.,	Alba, Pa.
88,764	April 6, 1869.	E. Lynch,	Georgetown, D. C.
91,504	June 15, 1869.	H. L. Wilcox,	Percival, Ia.
92,484	July 13, 1869.	C. Smith,	Bell Air, O.
93,910	Aug. 17, 1869.	N. C. Russell,	Gloversville, N. Y.
98,916	Jan. 18, 1870.	W. B. Brittingham,	La Fayette, Ind.
100,520	Mar. 8, 1870.	A. D. Fullmer,	Buffalo, N. Y.
101,243	Mar. 29, 1870.	E. England,	Mossy Creek, Tenn.
104,276	June 14, 1870.	G. W. Crabtree and J. G. Stoakes,	Chocoville, Ark.
104,734	June 28, 1870.	J. Henry,	New York, N. Y.
104,741	June 28, 1870.	J. Kidder,	Urbana, O.
107,177	Sept. 6, 1870.	C. L. Jenkins,	Omaha, Neb.
109,714	Nov. 29, 1870.	W. B. Brittingham,	La Fayette, Ind.
110,562	Dec. 27, 1870.	W. H. Fuller,	Brockport, N. Y.
111,214	Jan. 24, 1871.	F. A. Holcomb and S. B. Jenks,	Grand Rapids, Mich.
111,583	Feb. 7, 1871.	W. C. Stone,	Derby Lane, Vt.

No.	Date.	Inventor.	Residence.
112,285	Feb. 28, 1871.	A. Rock,	New Orleans, La.
114,596	May 9, 1871.	G. Pile,	Blountsville, Tenn.
116,578	July 4, 1871.	L. Falkeman,	San Francisco, Cal.
118,089	Aug. 15, 1871.	D. Woodbury,	Peabody, Mass.
120,606	Nov. 7, 1871.	R. P. Wilson,	New York, N. Y.
122,142	Dec. 26, 1871.	B. F. Wright,	Winchester, Mass.
123,748	Feb. 13, 1872.	C. J. Tinnerholm,	Quincy, Ill.
125,020	Mar. 26, 1872.	J. Carter, A. C. Keith,	Jersey City, N. J.
127,947	June 18, 1872.	J. Barran,	Cincinnati, O.
128,246	June 25, 1872.	J. Peters,	St. James, Mo.
128,938	July 9, 1872.	H. W. Southworth,	Springfield, Mass.
133,021	Nov. 12, 1872.	J. R. Enos,	Peabody, Mass.
133,140	Nov. 19, 1872.	S. Blanchard, Jr.,	Ashland, N. J.
135,214	Jan. 28, 1873.	A. Fleischaner,	Brooklyn, N. Y.
136,082	Feb. 18, 1873.	W. Maynard,	Salem, Mass.
136,488	Mar. 4, 1873.	J.Carter and A.Keith,	Jersey City, N. J.
138,138	April 22, 1873.	J. Davis and J. Armstrong,	Pittston, Pa.
139,892	June 17, 1873.	C. Herveux,	Islington, Eng.
140,040	June 17, 1873.	J. B. Hite,	Gyandotte, W. Va.
141,459	Aug. 5, 1873.	G. Rawle, W. N. Evans,	Bristol, Eng. Bedminster, Eng.
144,500	Nov. 11, 1873.	R. Blake,	Pontiac, Ill.
146,742	Jan. 27, 1874.	J. Anderson,	Mount Pleasant, Pa.
149,954	April 21, 1874.	H. Royer,	San Francisco, Cal.
150,405	May 5, 1874.	E. F. Dieterichs,	Philadelphia, Pa.
153,464	July 28, 1874.	L. M. Stockton, D. Stockton, and W. A. Ward,	London, Canada.
153,636 158,608	July 28, 1874. Jan. 12, 1875.	C. J. Tinnerholm,	Keokuk, Ia.
160,440	Mar. 2, 1875.	H. Klemm, C. Klemm,	Pfullingen, Germany.
160,902	Mar. 16, 1875.	R. Hart,	Gloversville, N. Y.
162,140	April 20, 1875.	G. A. Bartenbach and C. Richter,	Detroit, Mich.
163,191	May 11, 1875.	A. Haswell and J. C. Long,	Webster City, Ia.
164,792	June 22, 1875.	E. A. Baldwin, C. A. Holcombe,	Phelps County, Neb. Lincoln, Neb.
165,314	July 6, 1875.	A. D. Meritens,	Paris, France.
165,348	July 6, 1875.	E. Manasse,	Napa, Cal.
167,866	Sept. 21, 1875.	J. Angus,	Calais, Me.
169,076	Oct. 26, 1875.	E. Bauer,	Williamsburgh, N. Y.
169,102	Oct. 26, 1875.	R. Hart,	Gloversville, N. Y.

No.	Date.	Inventor.	Residence.
170,100	Nov. 16, 1875.	H. W. Mirrill and J. W. Hoitt,	Lynn, Mass.
170,623	Nov. 30, 1875.	H. Ely,	Ballston Spa, N. Y.
171,753	Jan. 4, 1876.	H. W. Adams,	Philadelphia, Pa.
174,761	Mar. 14, 1876.	J. Bent,	Lowell, Mass.
176,162	April 18, 1876.	W. E. Brock,	Philadelphia, Pa.
176,606	April 25, 1876.	J. L. de Montoison,	Manchester, Eng.
178,305	June 6, 1876.	A. C. Krueger,	San Francisco, Cal.
178,468	June 6, 1876.	C. Richter,	Detroit, Mich.
180,563	Aug. 1, 1876.	P. J. Dussand and J. Duchez,	Bordeaux, France.
180,947	Aug. 8, 1876.	J. A. J. Schultz,	St. Louis, Mo.
181,061	Aug. 15, 1876.	W. Farris,	Yarmouth, Me.
181,621	Aug. 29, 1876.	A. M. Barnes and W. F. Yocom,	Weston, Mo.
182,106	Sept. 12, 1876.	Wm. Coupe,	South Attleborough, Mass.
182,198	Sept. 12, 1876.	J. J. Johnson,	Columbus, O.
182,368	Sept. 19, 1876.	J. Kent,	Gloversville, N. Y.
182,684	Sept. 26, 1876.	H. Loescher,	Chicago, Ill.
183,377	Oct. 17, 1876.	S. A. Darrach,	Orange, N. J.
184,114	Nov. 7, 1876.	M. J. Söderberg,	Malmo, Sweden.
185,799	Dec. 26, 1876.	P. Sweeney,	New York, N. Y.
187,492	Feb. 20, 1877.	J. A. J. Schultz,	St. Louis, Mo.
191,374	May 29, 1877.	H. Royer,	San Francisco, Cal.
196,672	Oct. 30, 1877.	J. Kent,	Gloversville, N. Y.
198,477	Dec. 25, 1877.	J. Wells,	Wilmington, N. C.
199,054	Jan. 1, 1878.	G. Goodwin,	Cookshire, Quebec, Can.
200,108	Feb. 5, 1878.	C. J. Tinnerholm,	Brooklyn, N. Y.
208,510	Oct. 1, 1878.	H. Breisacher,	New York, N. Y.
208,548	Oct. 1, 1878.	E. Tivet,	Philadelphia, Pa.
217,042	July 1, 1879.	E. W. Avery,	Plymouth, N. H.
221,187	Nov. 4, 1879.	G. Plumer and C. P. Kerans,	Peabody, Mass.
221,199	Nov. 4, 1879.	P. Turner and J. Turner,	Chicago, Ill.
221,219	Nov. 4, 1879.	M. L. Doty,	Winterset, Ia.
223,200	Dec. 30, 1879.	J. Wells,	Wilmington, N. C.
229,928	July 13, 1880.	T. P. Tucker,	Independence Co., Ark.
230,225	July 20, 1880.	S. Bloom,	San Francisco, Cal.
230,841	Aug. 3, 1880.	S. Ullmo,	Lyons, France.
236,559	Jan. 11, 1881.	R. F. Dobson,	Darlington, Wis.
237,630	Feb. 8, 1881.	J. S. Swan,	Mongaup Valley, N. Y.
240,493	April 19, 1881.	G. D. Zonca,	Venice, Italy.
243,923	July 5, 1881.	R. Koenitzer,	St. Louis, Mo.
250,241	Nov. 29, 1881.	W. Harris,	Forrest City, Me.
254,962	Mar. 14, 1882.	J. W. Hammond,	Osceola, Pa.

No.	Date.	Inventor.	Residence.
255,326	Mar. 21, 1881.	J. M. Oardway and Jas. Oardway,	Boston, Mass.
257,442	May 2, 1882.	J. Head,	Hornellsville, N. Y.
262,516	Aug. 8, 1882.	M. Turley,	Council Bluffs, Ia.
262,924	Aug. 22, 1882.	J. B. Bollman,	Dayton, O.
271,804	Feb. 6, 1883.	J. F. Crawford,	Oak Hill, Ala.
289,588	Dec. 4, 1883.	A. J. Weeks and J. E. Weeks,	Littleton, N. H.

List of all Patents for Processes Employing Apparatus for Tanning Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
	July 9, 1808.	S. Parker,	
	Oct. 9, 1812. Dec. 30, 1812.	W. Edwards,	
	Nov. 4, 1831.	A. Conwell,	
	Dec. 16, 1833.	G. H. Richards,	
1,079	Feb. 9, 1839.	W. Brown,	Thompson, N. Y.
1,160	May 30, 1839.	W. Herapath,	Bristol, England.
1,455	Dec. 31, 1839.	L. R. Palmer,	Maryland, N. Y.
1,906	Dec. 17, 1840.	W. Buchanan,	Milford, Pa.
2,868	Dec. 5, 1842.	D. H. Mason,	Dahlonega, Ga.
3,614	June 5, 1844.	J. Cox,	Georgie Mills, Scotland.
3,632	June 15, 1844.	R. Downey,	New Albany, Ind.
3,688	Aug. 1, 1844.	W. Brown,	Manchester, Md.
4,253	Nov. 1, 1845.	F. D. Parmele,	Akron, O.
5,165	June 19, 1847.	L. C. England,	New York, N. Y.
7,089	Feb. 12, 1850.	W. H. Rosensteel,	New Oxford, Pa.
7,192	Mar. 19, 1850.	J. R. Innis,	Easton, Pa.
8,500	Nov. 4, 1851.	W. B. Milligan,	Edinburg, Va.
9,555	Jan. 25, 1853.	H. Britney,	Springfield, O.
11,061	June 13, 1854.	N. Dodge,	Oxford, N. H.
14,375	Mar. 4, 1856.	A. Steers,	Medina, N. Y.
19,211	Jan. 26, 1858.	C. A. Shaw and J. Clark,	Biddeford, Me.
21,126	Aug. 10, 1858.	L. C. England,	Owego, N. Y.
22,717	Jan. 25, 1859.	L. C. England,	Owego, N. Y.
23,360	Mar. 29, 1859.	T. T. Fergusson,	New York, N. Y.
24,208	May 31, 1859.	J. Gore,	Milford, N. H.
24,457	June 21, 1859.	J. Gore,	Milford, Conn.
24,560	June 28, 1859.	D. L. Hubbard,	Glastenbury, Conn.
24,727	July 12, 1859.	L. C. England,	Owego, N. Y.
25,045	Aug. 9, 1859.	J. B. Reed,	Cold Spring, N. Y.

No.	Date.	Inventor.	Residence.
29,656	Aug. 21, 1860.	D. Aldrich,	St. Louis, Mo.
30,062	Sept. 18, 1860.	W. H. Heald,	Baltimore, Md.
33,448	Oct. 8, 1861.	S. J. Patterson,	Bridgeport, Conn.
34,815	April 1, 1862.	W. Bush,	Wilmington, Del.
40,575	Nov. 10, 1863.	V. E. Rusco,	Chicago, Ill.
43,013	June 7, 1864.	W. Fields and J. Townsend,	Wilmington, Del.
43,258	June 21, 1864.	H. Leibermann,	Paducah, Ky.
43,787	Aug. 9, 1864.	J. Mauren,	Marseilles, France.
47,844 Reissue 2,519	May 23, 1865. Mar. 19, 1867.	B. H. McNulty and W. Kern,	Philadelphia, Pa. Mansfield, O.
48,361	June 27, 1865.	O. H. Brewer,	Shannon, Ill.
50,228	Oct. 3, 1865.	C. R. Dean,	Randolph, N. Y.
50,998	Nov. 21, 1865.	H. W. Adams,	Irvington, N. J.
51,655	Dec. 19, 1865.	H. Leibermann,	Paducah, Ky.
51,870	Jan. 2, 1866.	T. Sharp,	Nashville, Tenn.
55,333	June 5, 1866.	M. H. Merriam and E. L. Norton,	Charlestown, Mass.
57,275	Aug. 21, 1866.	G. Aymard,	New York, N. Y.
59,157	Oct. 30, 1866.		Bromfield, Me.
59,469	Nov. 6, 1866.	J. Snell, Jr.,	Patterville, Pa.
60,524	Dec. 18, 1866.	J. J. Johnson,	Allegheny City, Pa.
63,869	April 16, 1867.	C. J. Dumery,	Paris, France.
68,861	Sept. 17, 1867.	L. C. England,	Owego, N. Y.
75,391	Mar. 10, 1868.	C. Doty,	
76,134	Mar. 31, 1868.	H. W. Adams,	Irvington, N. J.
76,777	April 14, 1868.	L. L. Kelly,	Delaware Station, Ind.
76,784	April 14, 1868.	J. W. Lull,	Glen Hope, Pa.
76,957	April 21, 1868.	D. Symonds,	Marlow, N. H.
80,981	Aug. 11, 1868.	H. Lucas,	Rousburgh, O.
82,815	Oct. 6, 1868.	A. G. Eaton,	Gouverneur, N. Y.
84,190	Nov. 17, 1868.	S. Hosmer,	Concord, Mass.
88,764	April 6, 1869.	E. Lynch,	Georgetown, D. C.
92,615	July 13, 1869.	J. E. Kauffelt,	Shrewsbury, Pa.
92,776	July 20, 1869.	O. W. Bean,	Farmington, Tex.
101,213	Mar. 29, 1870.	O. W. Bean and W. B. Rowland,	Tecumseh, Mich.
101,661	April 5, 1870.	L. T. Robinson,	New York, N. Y.
101,812	Aug. 12, 1870.		Wilmington, Del.
105,169	July 12, 1870.	J. Champion,	Woburn Centre, Mass.
106,209	Aug. 9, 1870.	J. Robinson, S. F. Robinson, C. C. Putnam,	Skowhegan, Me.
112,285	Feb. 28, 1871.	A. Rock,	New Orleans, La.
112,332	Feb. 28, 1871.	L. C. England,	Philadelphia, Pa.

No.	Date.	Inventor.	Residence.
118,034	Aug. 15, 1871.	W. Masek,	Nashville, Ky.
119,238	Sept. 26, 1871.	W. Morris,	Philadelphia, Pa.
119,822	Oct. 10, 1871.	W. Coburn, F. Winslow,	East Walpole, Mass. South Dedham, Mass.
123,105	Jan. 30, 1872.	K. M. Jarvis,	Peabody, Mass.
139,892	June 17, 1873.	C. Harveux,	Islington, England.
158,438	Jan. 5, 1875.	H. Reed,	Atlanta, Ga.
159,510	Feb. 9, 1875.	C. Haserick,	Maynard, Mass.
180,563	Aug. 1, 1876.	P. J. Dussand and J. Duchez,	Bordeaux, France.
218,539	Aug. 12, 1879.	G. King,	Washington, D. C.
236,659	Nov. 23, 1880.	J. Davis,	Allegheny, Pa.
242,954	June 14, 1881.	C. Michel, Jr., C. Kollen, G. Hertzog,	Reims, France.
245,142	Aug. 2, 1881.	J. Davis,	Allegheny, Pa.
266,174	Oct. 17, 1882.	W. Masek,	Philadelphia, Pa.
274,336	Mar. 20, 1883.	B. D. Hyam,	Washington, D. C.
278,331	May 29, 1883.	D. Halsey, Jr.,	Newark, N. J.
278,981	June 5, 1883.	E. R. Locke,	Keene, N. H.
290,885	Dec. 25. 1883.	B. D. Hyam,	Washington, D. C.

List of all Compounds and Materials for Tanning and also for Tawing Leather and for Preparing Raw Hides, that are especially claimed or mentioned in any Patent, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
836	July 12, 1838.	A. A. Hayes,	Roxbury, Mass.
4,007	April 22, 1845.	G. C. Close and E. Field,	Port Chester, N. Y.
9,181	Aug. 10, 1852.	A. K. Eaton,	Rochester, N. Y.
9,406	Nov. 16, 1852.	D. Kennedy,	Reading, Pa.
12,102	Dec. 19, 1854.	G. Reynolds,	Bangor, Me.
12,139	Jan. 2, 1855.	O. Rich,	Cambridge, Mass.
13,443	Aug. 14, 1855.	O. B. Wattles,	Waddington, N. Y.
15,157	June 17, 1856.	J. P. Williams,	Salem, Mass.
17,043	April 14, 1857.	D. H. Kennedy,	New Alexandria, Pa.
17,867	July 28, 1857.	J. Carle,.	Kingston Township, Pa.
18,030	Aug. 18, 1857.	L. L. A. Elie de la Peyrouse,	Paris, France.
19,756	Mar. 30, 1858.	C. Daniels,	Elkhorn, Wis.
21,755	Oct. 12, 1858.	B. Harrington and N. Russell,	China, Me.
23,471	April 5, 1859.	H. Johnson,	Farmersville, N. Y.
25,241	Aug. 30, 1859.	J. Brainard and W. H. Burridge,	Cleveland, O.

No.	Date.	Inventor.	Residence.
25,522	Sept. 20, 1859.	T. S. Page,	Milan, O.
26,800	Jan. 10, 1860.	R. B. Thompson,	Gailesburg, Ill.
27,088	Feb. 7, 1860.	P. Daniels,	Le Roy, N. Y.
27,648	Mar. 27, 1860.	J. Unessley,	Gowanda, N. Y.
27,859 29.143	April 10, July 17, 1860.	J. Connell,	Port Huron, Mich.
29,488	Aug. 7, 1860.	A. Hill,	Dubuque, Ia.
30,220	Oct. 2, 1860.	R. Harper,	Trumbull, O.
30,367	Oct. 9, 1860.	J. L. Wells,	St. Louis, Mo.
30,390	Oct. 16, 1860.	R. Crane and W. Baldwin,	Anamosa, Ia.
30,392	Oct. 16, 1860.	A. Dietz,	New York, N. Y.
32,526	June 11, 1861.	H. McKenzie,	Talladega, Ill.
33,314 Reissue 2,310	Sept. 17, 1861.	P. W. Thomas,	Levee, Ky.
33,388 Reissue 2,384	Oct. 1, 1861.	G. W. Hatch,	Princeton, Ill.
33,564 Reissue 2,560	Oct. 29, 1861.	W. Beach,	Hamden, Conn.
33,790	Nov. 26, 1861.	J. M. Muller,	Richmondville, N. Y.
34,609	Mar. 4, 1862.	J. Brainerd,	Cleveland, O.
38,525	May 12, 1863.	H. C. Williams,	Lancaster, Pa.
41,666	Feb. 16, 1864.	J. Wonder,	Trucksville, Pa.
43,188	June 21, 1864.	S. Dunseith,	Philadelphia, Pa.
44,234	Sept. 13, 1864.	J. W. Taylor,	North Collins, N. Y.
46,443	Feb. 21, 1865.	G. Bottero,	Boston, Mass.
46,646	Feb. 21, 1865.	C. Burton,	Union, Me.
49,886	Sept. 12, 1865.	E. Keith and B. Thorn,	La Fontaine, Ind.
50,662	Oct. 24, 1865.	J. Price,	Edgefield District, S. C.
50,872	Nov. 7, 1865.	S. A. Hickel,	Roan Co., W. Va.
51,407	Dec. 5, 1865.	J. E. Park,	Seguin, Texas.
53,688	April 3, 1866.	J. Schultz,	Ellenville, N. Y.
57,409	Aug. 21, 1866.	W. H. Towers,	New York, N. Y.
57,795	Sept. 4, 1866.	J. N. Sturtevant and H. E. Jones,	McGregor, Ia.
59,251	Oct. 30, 1866.	H. Napier,	Elizabeth, N. J.
60,472	Dec. 18, 1866.	J. W. Calef,	Salisbury, N. H.
60,548 60,549	Dec. 18, 1866. Dec. 18, 1866.	J. A. Pease,	New York, N. Y.
60,701	Jan. 1, 1867.	J. Davis and J. McKelvey,	Pawtucket, R. I.
65,323	May 28, 1867.	F. H. Wright,	Richmond, Ind.
65,934	June 18, 1867.	W. H. Newby,	Seymour, Ind.

No.	Date.	Inventor.	Residence.
66,432	July 2, 1867.	J. Campbell,	Leona, Pa.
67,563	Aug. 6, 1867.	J. Mehan,	Newark, N. J.
68,335	Sept. 3, 1867.	A. Appleby,	Brownfield, Me.
68,511	Sept. 3, 1867.	W. Johnson,	Shirleysburg, Pa.
68,631	Sept. 10, 1867.	G. L. Loversidge,	Burry Bank Cottages, Eng.
69,636	Oct. 8, 1867.	C. J. Cushing, B. F. Walls, and W. A. Wood,	Hancock Co., Ky.
71,293	Nov. 26, 1867.	C. Frank,	Cincinnati, O.
75,535	Mar. 17, 1868.	J. Diehl,	East Freedom, Pa.
75,794	Mar. 24, 1868.	L. S. Robbins,	New York, N. Y.
76,957	April 21. 1868.	D. Symonds,	Marlow, N. H.
77,099	April 21, 1868.	L. F. Robertson,	West Farms, N. Y.
78,672	June 9, 1868.	E. Keith and A. A. Eylar,	Wabash, Ind. Pontiac, Ill.
80,693	Aug. 4, 1868.	W. Windoes,	Fond du Lac, Wis.
81,237	Aug. 8, 1868.	J. Wood,	Woodstock, Vt.
81,587	Sept. 1, 1868.	G. Bossière,	Paris, France.
82,517	Sept. 29, 1868.	B. F. Gross,	Trenton, Tenn.
83,073	Oct. 13, 1868.	S. Lusten,	Linesville, Pa.
84,169	Nov. 17, 1868.	C. J. Bugh,	Eau Claire, Wis.
84,734	Dec. 8, 1868.	N. Cox,	Salem, Ill.
86,808	Feb. 9, 1869.	J. P. Bridge,	Boston, Mass.
91,504	June 15, 1869.	H. L. Wilcox,	Percival, Ia.
93,498	Aug. 10, 1869.	N. A. Thornton,	Conikee, Ala.
94,805	Sept. 14, 1869.	J. Wood,	Woodstock, Vt.
98,884	Jan. 18, 1870.	F. P. Porcher,	Charleston, S. C.
104,276	June 14, 1870.	G. W. Crabtree and G. Stoakes,	Chocoville, Ark.
107,713	Sept. 27, 1870.	C. F. Panknin,	Charleston, S. C.
109,714	Nov. 29, 1870.	W. B. Brittingham,	La Fayette, Ind.
110,562	Dec. 27, 1870.	W. H. Fuller,	Brockport, N. Y.
111,562	Feb. 7, 1871.	W. Parks,	Meadville, Pa.
112,285	Feb. 28, 1871.	A. Rock,	New Orleans, La.
114,941	May 16, 1871.	A. Hisey,	Tama City, Ia.
115,100	May 21, 1871.	F. P. Porcher,	Charleston, S. C.
117,241	July 25, 1871.	A. T. Atherton,	Lowell, Mass.
123,118	Jan. 30, 1872.	J. M. Müller,	Cobbleskill, N. Y.
125,020	Mar. 26, 1872.	J. Carter and A. C. Keith,	Jersey City, N. J.
128,938	July 9, 1872.	H. W. Southworth,	Springfield, Mass.
132,269	Oct. 15, 1872.	W. Farris,	Yarmouth, Me.
140,040	June 17, 1873.	J. B. Heite,	Guyandotte, W. Va.
143,105	Sept. 23, 1873.	W. Thilmany,	Cleveland, O.
144,500	Nov. 11, 1873.	R. Blake,	Pontiac, Ill.
146,742	Jan. 27, 1874.	J. Anderson,	Mt. Pleasant, Pa.

No.	Date.	Inventor.	Residence.
148,056	Mar. 3, 1874.	G. W. Hatch,	Lawrence, Kan.
153,464	July 28, 1874.	T. M. Stockton, D. Stockton, and W. A. Ward,	London, Can.
159,366	Feb. 2, 1875.	W. R. Stace,	Rochester, N. Y.
163,191	May 11, 1875.	A. Haswell and J. C. Long,	Webster City, Ia.
164,792	June 22, 1875.	E. A. Baldwin and C. A. Halcombe,	Phelps Co., Neb. Lincoln, Neb.
165,348	July 6, 1875.	E. Manasse,	Napa, Cal.
165,731	July 20, 1875.	G. Herrick,	Kilbourn City, Wis.
165,822	July 20, 1875.	G. W. Hatch,	Lawrence, Kan.
169,076	Oct. 26, 1875.	E. Bauer,	Williamsburg, N. Y.
174,110	Feb. 29, 1876.	E. Bradley,	St. Leonard, Can.
176,162	April 18, 1876.	W. E. Brock,	Philadelphia, Pa.
178,919	June 20, 1876.	J. Foley,	Montreal, Can.
182,368	Sept. 19, 1876.	J. Kent,	Gloversville, N. Y.
185,799	Dec. 26, 1876.	P. Sweeney,	New York, N. Y.
193,520 193,521	July 24, 1877.	F. Knapp,	Brunswick, Germany,
196,081	Oct. 16, 1877.	F. Funke,	Detroit, Mich.
196,339	Oct. 23, 1877.	G. De Cordova, M. Wise, H. D. Darrell,	Brooklyn, N. Y. New York, N. Y. Brooklyn, N. Y.
198,478	Dec. 25, 1877.	J. Wells,	Wilmington, N. C.
200,108	Feb. 5, 1878.	C. J. Tinnerholm,	Brooklyn, N. Y.
230,841	Aug. 3, 1880.	S. Ullmo,	Lyons, France.
231,035	Aug. 10, 1880.	P. Gondolo,	Paris, France.
231,489	Aug. 24, 1880.	J. Holtz,	Berlin, Prussia, Germany.
235,923	Dec. 28, 1880.	H. L. Wilcox,	Lincoln, Neb.
236,115 236,280	Dec. 28, 1880. Jan. 4, 1881.	H. Trenk,	Berlin, Germany.
237,007	Jan. 25, 1881.	J. Foley,	Montreal, Can.
260,322	June 27, 1882.	C. Richter,	St. Paul, Minn.
262,766	Aug. 15, 1882.	C. T. Hayden,	Whitesborough, Tex.
271,804	Feb. 6, 1883.	J. F. Crawford,	Oak Hill, Ala.
283,798	Aug. 28, 1883.	E. Logue, M. T. Jones, and C. E. Morrill,	Deering, Me.
286,491	Oct. 9, 1883.	J. Shaw,	Hindmarsh, S. Australia.
287,255	Oct. 23, 1883.	F. E. Dietsch,	Woodbury Falls, N. Y.

CHAPTER XL.

TANNING AND COLORING HIDES AND SKINS WITH THE HAIR AND FUR ON.

Pingee obtained two patents for tanning hides with the hair on, the first being for the process of shaving off after the hide has been fleshed, the inner layer of the skin, or the same and a part of the corium preparatory to immersing the hide in the liquors. The second patent relates to the preparation and use of the tanning liquors.

1. For 25 hides use 5 hogsheads of water, 1 peck lime, 5 pounds sal-soda, and 12 pounds soda-ash; or, instead of the sal-soda and soda-ash, 15 pounds of soda-ash may be used. The hides remain in this solution for twelve or more hours; but not long enough to start the hair.

2. Rinses in cold water.

3. Steeps in a solution composed of 5 hogsheads of water, 1 bushel of muriate of soda, and 12 pounds of sulphuric acid. In this solution they remain twenty-four hours or more, according to the thickness of the hide, and are frequently stirred.

4. Immerses in a solution composed of 5 hogsheads of water and 50 pounds Bombay catechu.

5. Steeps the hides in strong bark-liquor, in which they remain ten or twelve days.

6. Adds to the bark-liquor 50 pounds sumach and 25 pounds ground alum, and suffers the hides to remain one week longer in such solution; but stirs them occasionally in the mean time, and the process is completed.

Johnson. For tanning light skins with the hair on them—such as sheep, fox, coon, or minx-skins, etc.—1. Soaks, fleshes, and cleans in the usual manner. 2. Makes a solution in the following proportions: to ½ bushel wheat-bran add 6 gallons of soft, hot water, and let it stand in a warm room, and agitate until it ferments. Then strain out the liquor and dissolve

therein 4 pounds of chloride of sodium or common salt, and then add $1\frac{1}{2}$ pounds sulphuric acid while agitating the liquor. This liquor acts as a mordant for settling a variety of colors, which are cheap and more durable than if made in the usual manner of sponging colors after tanning. 3. Light hides require to be handled in the above liquor for one to three hours. 4. Rinse and hang out to dry in the shade. 5. Stuff, when nearly dry, with a compound of $\frac{2}{3}$ fish oil, $\frac{1}{3}$ alcohol; to which add flour paste and melted tallow equal parts in order to thicken. To make this compound water-proof and India-rubber or beeswax. 6. Dry the skins.

Coe. 1. Soaks the light hide or skin with the wool, hair, or fur on. 2. Fleshes in the usual manner. 3. Makes a solution composed of 8 gallons soft water; 1 quart potatoes, boiled and mashed; 8 quarts rye or oat bran; 5 pounds common salt: $\frac{1}{2}$ pound oxalic acid. Stirs the potatoes and bran together with the water in the proportion above specified, and lets it stand in a warm room until it ferments. Then adds the salt, stirring until it is dissolved, and finally under continuous agitation adds the oxalic acid. This solution, which is termed the "first solution," imparts no color to the leather or fur. 4. For heavy hides or skins, such as calf-skins or cowhides, adds to the above solution a liquid made of the buds of sumach, melted catechu, and zinc mixed together in about the following proportions: 1 quart extract of the butts of sumach, 3 pounds melted catechu or Sicily sumach, $\frac{1}{4}$ pound kino or cranes bill. It is claimed that this solution plumps and gives the leather a body. Light hides require to be handled from thirty minutes to one hour; they are then rinsed in soft, warm water, and hung out in the shade to dry. 5. When the hides or skins are nearly dry they are stuffed with oil, tallow, and flour paste, and then hung in the air to dry.

Carter and Keith's process is adapted for tanning hides and skins with the hair on, and for dressing furs.

In carrying this invention into practice, prepare a solution composed of the following ingredients in substantially the proportions named: Carbonate of soda, three pounds; nitrate of potash, three ounces; chloride of sodium, three ounces; prus-

siate of potash, three ounces; acetate of lead, three ounces; green vitriol, three ounces; soft water, nine gallons. In place of the carbonate of soda, three gallons of common lye may be used, if preferred. Pulverize the ingredients and dissolve them in the water while hot. The skins to be tanned must be fleshed in the usual manner, whether green or dry. If dry, they must be soaked in water until softened. They are then immersed in the above solution, which is kept at a lukewarm temperature, and are handled or agitated to expose all parts equally to the action of the liquid. The time which they are required to remain in the solution to become tanned varies with the kind and thickness of the skin from thirty minutes to two hours. After having been in the solution a sufficient time they are taken out, when it will be found that the hair or wool is loosened and the grain raised, so that they should be handled with care and immediately on removal from the solution rinsed in cold water, which will reset the hair and prevent depilation, and after being rinsed they are hung up in the shade to dry.

The skins having been tanned and dried, must now be treated with the following composition: Soft soap, one gallon; fish oil, one quart; borax, one ounce; chloride of soda, four ounces; alcohol, four ounces; all of which ingredients are thoroughly mixed in two quarts of hot soft water. The dried skins which are dressed with the hair, wool, or fur on must be washed with the composition on the flesh side only, and this repeated as many times as necessary to render them somewhat soft, and in a condition to be worked soft by rubbing or beating. The tanning-liquid does not affect the hand injuriously, and acts as a disinfectant of any fetid or offensive odor that appertains to the skins, whereby the natural oil and impurities of wool are decomposed and furs are cleansed and rendered fit for wear; the treatment also serving as a preventive against the attacks of moth.

Tanning and Coloring Beaver, Otter, and any other Skins with the Hair or Fur on.

Bugh's Method for Tanning Beaver, Otter, or any other Skins, with the Hair or Fur on.—The skins according to this method should be soaked (if dry) from 12 to 16 hours, then thoroughly fleshed, then returned to the soak for from 6 to 8 hours longer.

They should then be washed as follows :—

Take sufficient warm, soft water to wash them, to which add sal-soda until the water feels slippery, then wash thoroughly; next wash them well in warm, strong soapsuds, then rinse well through 2 or 3 waters, and wring out as dry as possible. The skins are then ready for the tan-liquor, which is prepared as follows :—

2 gallons cold, soft water.
2 pounds Glauber's salts.
1 pound alum.
1 pound common salt.
½ an ounce sulphate of zinc.

Melt 1 pound terra japonica in ½ gallon of the above preparation, over a slow fire, then mix all together.

All the ingredients should be pulverized, as they will dissolve much more quickly.

Place the skins in the tan, and handle by pulling and stretching thoroughly, then let remain 2 or 3 days; if heavy furs, such as bear-skins, 4 or 5 days.

Then rinse in 3 or 4 clean waters, wring out as dry as possible, and hang in the shade to dry. When nearly dry, work them occasionally by stretching, etc., or on the beam with the fleshing-knife. When dry, finish up on the beam, by working the middle or thick part of the skin down, until it is even, or as thin as the edges or flanks.

A currying-knife, with a fine edge, is the best tool to do this with, or it may be done with coarse sand-paper, rolled on a round stick, using it the same as a knife.

If it is desired to pluck the hides, after washing them through the alkali, and rinsing, lay them in clean, cold water for a day or two longer, or until the "guard-hairs" pull out without breaking.

Care must be taken not to let the skin taint. If it does, it will loosen the fur, as the fur is only on the grain while the "guard-hairs" go through into the pelt.

Muskrats have very tender skins, which should be treated somewhat differently from heavier furs.

Soak in clean, cold water for 10 or 12 hours, or until all hard

spots are softened; then flesh as well as possible; then wash as directed to wash furs; then put them in the tan-liquor for furs; handle the same as other furs, and let remain for two or three hours; then wring out, and flesh again, and return to tan-liquor for two or three hours longer; then wring and rinse, and finish up as directed for finishing furs. If the skins are well fleshed the first time, a second fleshing is not necessary.

A rich, nice gloss will be formed on all furs, if tanned and finished as described.

To Color Furs.

After soaking soft, wash in a middling-strong sal-soda water, and rinse clean.

Then apply with a brush, and rub well through the fur down to the pelt, half an ounce crystallized nitrate of silver, and one pint of soft water, and hang in the sun to dry.

Again apply with a brush, and rub well through the fur, one ounce sulphate of potash, dissolved in one pint soft water, and hang in the sun to dry, and, when dry, rinse off, and hang in the shade to dry, and work occasionally while drying.

Method and Machine for Dyeing the Wool on Sheep-Skins.

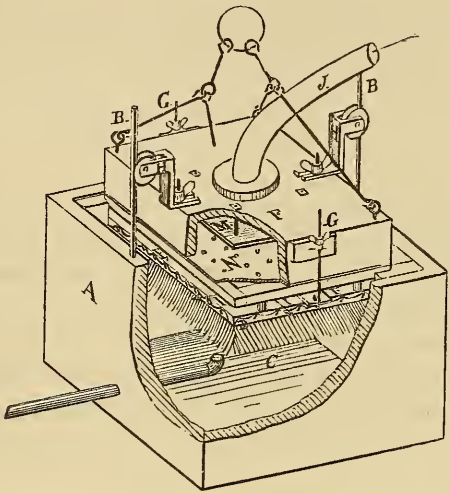
Alexander Jack, of Barnet, Vt., in 1875 patented the apparatus shown in Fig. 292 for dyeing the wool on sheep-skin, whereby the skin is kept perfectly cool during the operation of dyeing, thus preventing the skin from being injured, and at the same time there is no danger of cooling the dyeing-liquor. The invention also consists in a device whereby the apparatus, and consequently the skin attached to the same, are kept in the right position, so that the wool on the skin can be dyed a number of different colors during one operation.

Fig. 292 is a perspective view of Jack's apparatus with a portion of one of the ends removed, and showing the sheep-skin in position after dyeing.

A is a vat containing the dye-liquor. *B B* are the guide-rods attached to the vat *A*, which serve to keep the apparatus, to which the skin is attached, in the right position. *C* is the wool

of the skin after being dyed. *D* is a strip of cloth hooked on points, and to which the skin is sewed. *E* is a frame which is attached to the air-chamber. *F* is the air-chamber. *G G* are the clamps, by means of which the frame containing the skin is

Fig. 292.



attached to the air-chamber. *H H* are the brackets attached to the air-chamber *F* containing guide-pulleys, which operate in connection with the guide-rods *B B* attached to the vat *A*. *I* is the space for the escape of the air after being used in cooling the skin. *J* is a flexible air-tube to convey the air to the air-chamber. *M* is a metal plate to break the force of the wind upon the centre of the air-chamber, so that the air in the chamber will be of uniform density, and be distributed evenly through the perforated plate upon the skin. The skin upon which is the wool to be dyed is first sewed to the cloth *D*, and then hooked to the points. The air is then forced into the air-chamber, the wool is lowered and raised a few times in the dye-liquor until sufficiently colored, after which it is removed. By means of the air admitted to the skin, the latter is always kept cool, and prevented from being injured on account of coming in contact with the hot steam of the dye-liquor, so that it is unnecessary to remove

the skin from the vat until the wool is dyed. By the escape of the air without coming in contact with the dye-liquor no trouble arises in consequence of cooling the liquor.

By the methods commonly in use but one immersion in the dye-liquor is permitted before taking the skin from the vat and cooling. It is then returned to the vat and once again immersed in the dye-liquor, and again removed from the vat, and this operation is continued until the wool on the skin is dyed. This method of dyeing is necessary in the processes commonly employed in order to prevent the skin from being injured by being too long a time in contact with the heat from the dye-liquor.

By means of the guides *B B* on the vat, and the pulley-brackets *H H* on the air-chamber, the latter, and consequently the skins attached to it, are always kept in uniform position in relation to the former, so that, instead of one vat containing only one color of dyeing-liquor, several vats containing different colors of dyeing-liquors, may be used to receive the air-chamber in succession, and the skins thereon be dyed accordingly.

CHAPTER XLI.

MINERAL TANNING.

We understand by this name such methods of tanning as those in which mineral substances are employed as tanning material instead of vegetable tannin.

Attemps to substitute mineral substances for vegetable tannin were made more than a hundred years ago.

By consulting the English patent reports it will be seen that the use of mineral salts, especially ferric salts, the tanning properties of which were first observed, was already attempted at the commencement of the last century. Ashton as early as 1794 obtained a patent for tanning with ferric salts, which were pre-

pared by treating iron rust or iron ores (pyrites) with sulphuric acid. Ashton also recommended the heating of other ores, such as copper ores, calamine, etc., with an addition of sulphur, and to pulverize and lixiviate the hot mass. By heating ores of copper, zinc, and iron with sulphur, sulphur combinations of the respective metals are formed which, when in aqueous solution, are very likely converted into sulphuric acid combinations, in which state they exert a tanning influence upon the skin.

The specification of the patent, which is very indefinite, directs the immersion of the skins in the solution of mineral salts prepared as above for five or six days with frequent handling.

Jules Bordier, in 1842, obtained a patent for converting hides into leather by means of mineral and earthy substances, recommending especially ferric sulphate as the most important combination. The ferric sulphate was to be prepared by treating solution of ferrous sulphate with manganese dioxide or nitric acid, with an addition of ferric hydrate. A red salt, not definitely described by the inventor, which is separated by boiling the mixture, is used for preparing the tanning-liquor.

Molac and Daniel Triedel, in 1855, obtained a patent, in which ferric salts were also described as the tanning material. The improvement claimed by them consisted in the neutralization of the sulphuric acid, separated in tanning by splitting off from the ferric sulphate by means of metallic oxides, such as ferric oxides, aluminium oxide, or zinc oxide.

It is claimed that by this process the skin absorbs more iron salts than by using ferric salts alone, and that the injurious effect of the free acid is prevented.

Triedel and Molac prepared their tanning-liquor by treating ferrous sulphate with manganese dioxide and sulphuric acid.[1]

To the solution of ferric and manganese salts obtained in this manner a varying quantity of ferric acetate was added.

The depilated and cleansed skins were soaked for 3 or 4

[1] The formula they give for this process is according to the old nomenclature: $4(SO_3, FeO) + 2MnO_2 + SO_3 = 3SO_3Fe_2O_3 + 2(SO_3MnO) + Fe_2O_3$. In this they start from the incorrect supposition that the fluid contained free ferric oxide and neutral ferric sulphate instead of basic ferric sulphate.

weeks first in weak solutions of the above salts compounded at first with some fermented crushed barley, after which the strength of the solutions was gradually increased. To neutralize the free acid, some ferric oxide was from time to time added to the solution. By this process it was claimed that the thickest hides would in six weeks be converted into leather equal in appearance and quality to that tanned in the ordinary manner.

The next advance in mineral tanning was made by Knapp, who, in 1861, obtained a patent in Germany for tanning with ferric salts and other metallic oxides. Hides tanned with mineral substances lost, like those tanned with alum, their tannin by immersion in water. Knapp tried to remove this evil by converting the metallic salts adhering externally to the skin into insoluble metallic soaps, by soaking and kneading the skin in a soap solution. In order to fix the tanning substance in the skin, Knapp recommended, instead of *immersing* the tanned skins in soap solution, the *fulling in* of insoluble soaps of ferric oxide, aluminium oxide, or chromium oxide. The solution of basic ferric sulphate Knapp used for tanning was prepared by compounding the solution with caustic soda until the resulting precipitate was again dissolved in the fluid.

Next to Knapp, Pfanhauser obtained in 1864 a patent for the preparation of a basic ferric sulphate and its use for tanning. By his process ferric sulphate is heated to a red heat with constant stirring until the mass is converted into a reddish powder. The latter while hot is thrown into water, in which, with constant stirring, it is almost entirely dissolved. The resulting fluid is allowed to clarify by standing, and the clear liquor used for preparing tanning-fluid of varying strength. The skins are first placed in a dilute solution of 0.5° Beaumé, and then successively in stronger solution. When thoroughly permeated they are washed off and placed in a soap solution.

The first use of *bichromates* for tanning was made by Cavalin. The skins, according to his method, are placed in a solution of 22 pounds of potassium bichromate and 44 pounds of alum in 396 pounds of water, where they remain for four or five days with frequent stirring, when they are placed in a solution of 2.2 pounds of ferrous sulphate in 22 pounds of water. In this they

remain for twelve hours, being in the mean while frequently stirred. The potassium bichromate is reduced to chromic oxide by the ferrous sulphate, and the ferrous oxide contained in the ferrous sulphate oxidized to ferric oxide, both oxides being precipitated as such upon the fibre, or the ferric oxide together with alumina. The fixing of the chromium combination is effected by reducing the soluble chromate to chromic oxide. Cavalin's method may be considered as a combination of tanning with ferric aluminium and chromic oxides. But a practical application of the process is not possible, since the leather loses its tannin easily when immersed in water, and its grain is brittle.

The use of iron alum and chrome alum was at one time proposed and actually introduced in practice. But the use of these substances was soon abandoned, as the leather prepared in this manner had no advantage over that tanned with alum and alumina salts.

All the above-mentioned methods of tanning have been abandoned on account of the defective quality of the product prepared by them. But this can scarcely be attributed to the properties of the tanning material, but rather to the errors committed in their preparation. By immersing leather prepared with these tanning materials in tan-liquor it was made closely to resemble that tanned in the ordinary manner.

Tanners had almost become accustomed to reject all new proposals to use mineral instead of vegetable tanning substances, justifying their action by referring to former failures, until Knapp, in 1877, gave a fresh impetus to the matter by patenting in Germany and other countries a new method of tanning with ferric salts. We will first describe Knapp's process as specified in the applications for patents.

Knapp's Process of Tanning with Ferric Salts.

In the use of the basic sulphate of iron as a tanning material, the hides or skins, having the hair and adherent fleshy portions removed in the usual manner, are placed in the cold solution of the ferric-oxide salt of the proper density, in which they are allowed to remain for two, or, at most, four days, during which

time it is not necessary to handle the hides in any manner, all the laborious operations attending the use of tan-bark liquor, while the hides or skins are subjected to the action of such liquor, being obviated. At the end of the time named the hides or skins are removed from the solution of ferric-oxide salt. This salt is prepared as follows: To a boiling solution of sulphate of protoxide of iron (green vitriol) is added as much nitric acid as will thoroughly oxidize the salt contained in said solution. When the effervescence which ensues upon the addition of the nitric acid has subsided, the operation is reversed—that is, sulphate of protoxide of iron is added to the solution till said solution assumes a syrupy consistence—a distinguishing characteristic aforementioned—and acquires a yellow-red color, also characteristic of solutions of this iron oxysalt, which, when slowly evaporated to dryness, has the appearance of an orange-red transparent varnish, also highly characteristic.

In this condition, it is claimed, the ferric sulphate possesses qualities differing essentially from those attributed to it in chemical text-books, or found in the commercial article. The latter gives no syrupy solution, is of a yellow-brown color, and in aqueous solution is decomposed by boiling, while the preparation produced according to the above method remains undecomposed by boiling even in a solution of 20° to 40° B. It is further claimed that the ferric sulphate prepared according to Knapp's method is more abundantly absorbed by the skin.

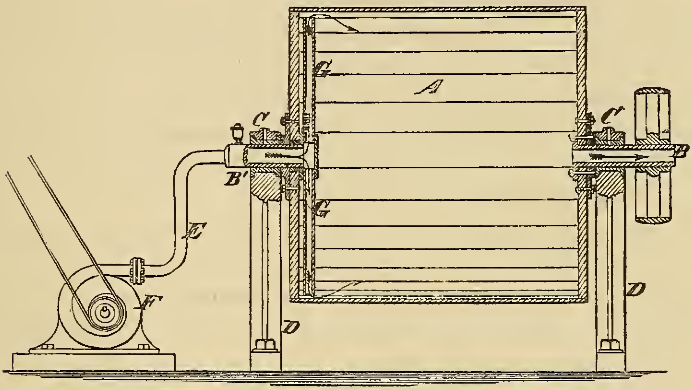
After tanning, the skins are treated with fat solutions and a so-called iron soap. Greasing the skins by hand, hanging them up in the drying-room and scraping off the excess of fat is done away with. Stearine and paraffine are suitable materials for the fat solution.

The iron soap is separated in an insoluble form by precipitating soap solution with Knapp's ferric salt. The iron soap prepared in this manner is mechanically fulled into the skin, a fulling drum constructed by Knapp being used for the purpose. This machine, shown partly in elevation and partly in section in Fig. 293, consists of a drum *A* revolving around the hollow trunnions *B B'*, through which air can be forced into the barrel by means of the fan *F*.

The trunnions are fitted in suitable boxes or bearings C in or on a supporting-frame D.

To one of the hollow trunnions is attached, by a suitable joint, a pipe or conductor, E, which leads from a centrifugal or other blower or pump, F. From the inner extremity of the trunnion to which the conductor E is attached extend radially

Fig. 293.



outward from the trunnion hollow arms, pipes, or conductors, G, their ends being brought quite near the inner surface of the drum A, and their ends near the inner surface being open.

The joint which connects the pipe or conductor E with the trunnion B' is of such a character as to permit the free turning of the trunnion on its bearing without turning the conductor.

When the apparatus is in operation the leather or tanned hides to be greased or treated with soap or other substance are placed in the drum A, which has a suitable opening in its side, provided with a cover (not shown) for the reception of the hides to be treated, and the proper quantity of the substance to be thereto applied is also placed in the drum. The drum is then rotated by means of a pulley, gear, or other suitable means. At the same time the blower F is set in operation, and air is driven through the trunnion B' into the drum and discharged on the inner surface. The air then passes toward the centre of the drum through the interstices and pores of the leather in the

drum, exerting a rapid drying action on the same, the removal of the water in the wet or damp skins being followed by the rapid and thorough absorption of the grease or substance it is desired to incorporate into the pores of the leather. Finally the air issues from the trunnion *B*.

A paste of iron soap described above is applied to the skin with or without an addition of fatty emulsions, or placed together with the skins in the fulling drum and mechanically fulled in. The skins are dried at the same time by the current of air passing through the fulling drum. The new and peculiar features claimed for this process by Knapp are as follows:—

1.[1] The preparation of the ferric salt, especially the treatment of the ferrous sulphate oxidized by nitric acid by a further addition of the same salt.

2. The treatment of the skins and hides with solutions of iron and fat.

3. The use of stearin for the above purpose.

4.[1] The fulling drum connected with a fan by which a current of air is forced into it.

5. The iron soap and its use.

The advantages of this method of tanning are, according to Knapp—

1. Greater cheapness (from 5 to 25 per cent.).
2. Considerable saving of time, the product being of an equal quality and durability.
3. The obtaining of as large a yield as by tanning in the ordinary manner.
4. The use of a tanning material of a constant chemical composition by which the obtaining of a uniform product is assured.

The leather prepared by Knapp's process has a brown-yellow color closely resembling that of leather tanned in the ordinary manner. It is, according to Knapp, not water-proof but capable of resisting water, meaning by this that the leather does not lose its tannin by frequent contact with water. As far as we

[1] By a decision of the patent office of the German empire, claims one and four have been set aside, as not being new.

know, this process has thus far only been used for the preparation of sole and belt leather, and we are unable to say whether upper leather has also been lately successfully produced.

We will say nothing further *pro et contra* in regard to this method.

Knapp has applied for an additional patent for a somewhat different method of preparing the ferric salts. Instead of adding, as formerly described, nitric acid to a boiling solution of ferrous sulphate, an equivalent quantity of sulphuric acid and sodium nitrate is added to the ferrous sulphate solution. The tanning with this is effected in the same manner as previously described, but can also be done by the precipitate which albuminous substances, as for instance that of blood, produce with the ferric solution.

Heinzerling's Method of Tanning with Chromates, etc.

In the years 1880 and 1881, Heinzerling obtained patents in the United States, and previously in other countries, for quick tanning with chromates with an addition of aluminium salts, sodium chloride, etc.

The process is executed as follows:—

The skins are cleansed, depilated, and swelled, and placed in a one-quarter per cent. solution of chromic acid or in a half per cent. solution of potassium bichromate, sodium bichromate, or magnesium bichromate or other neutral bichromates, or in a half per cent. solution of chromic salts, for instance chromic sulphate. It is advantageous to add to the solution one per cent. of alum or aluminium sulphate or other aluminium salts, and one per cent. of sodium chloride. According to their thickness the skins remain in the solution a shorter or longer time.[1] During this time the solution is successively concentrated until it contains as much as 6½ per cent. of chromates, 12 per cent. of alum, and 10 per cent. of common salt.

The action of tanning-liquors gradually increasing in strength can also be effected in a more simple manner by placing the

[1] Calf-skins, for instance, four to six days, and heavy bullock hides up to fourteen days.

skins successively in more concentrated solutions and allowing them to remain a corresponding time in each of the solutions.

When fresh skins are placed in the tanning-liquors, the tanning substance withdrawn by the skins taken out must be always supplemented, the quantity required being determined by analysis.

Although experience has shown that the tanning process can be executed without the use of aluminium combinations and of common salt, it is advantageous to employ them, since these substances possess also tanning properties and accelerate the process, and besides being comparatively cheap, reduce the cost of the operation.

If leather is to be produced which is to be blackened after tanning, 2 to 3 per cent. of potassium ferric-cyanide or potassium ferro-cyanide is added to the solution. These substances, together with the iron black applied later on, give a deep dark-blue color to the leather.

After tanning in the described solutions, the skins are placed in a 4 to 8 per cent. solution of barium chloride, acetate of lead, or soap, which effects a partial fixing of the tanning substance by the latter forming with the first insoluble salts or soaps.

To effect a quicker absorption of the barium chloride, acetate of lead, or soap, the skins, while in the solutions, are vigorously moved or kneaded. They are next washed, superficially dried and stretched, and, while still feeling somewhat moist, placed for 36 hours in a solution of stearine, paraffine, wax, rosin, colophony, spermaceti, or of other hydrocarbons or fat, in benzine or other solvents having a similar effect.

It is advantageous to heat the solution containing fat, paraffine, or other hydrocarbons to 96.8° F. in a water-bath. In place of stearine or the other substances mentioned, a mass resembling caoutchouc can be used, which is obtained by treating oils (linseed or rape-seed oil) with 10 to 15 per cent. of chloride of sulphur. If chromic acid is used in tanning, the paraffine employed in the after-treatment is oxidized by the acid, the latter being at the same time reduced to chromic oxide. The paraffine appears to become oxidized to an acid-like combination which enters with the chromic oxide, formed into a combination

insoluble in water which is firmly precipitated upon the fibre. When chromates are used, the chromic acid is split off from the chromates during the tanning process, either by the skin itself or, in case aluminium salts are employed, by the sulphuric acid liberated from them. By the succeeding treatment with paraffine, etc., the insoluble combination described above is also formed. As a proof of the described action upon the paraffine taking place, we would mention the fact that the cut surface of leather prepared according to the described process is at first yellow but becomes gradually lighter, especially when exposed to the light, and turns finally to a nearly whitish-green. Metallic salts, for instance cupric sulphate and others, can be added to the solution of chromates formerly mentioned, partly on account of the tanning effect of these salts, and partly in order to produce certain shades of color upon the leather.

The skins can also be placed, either before or after they have been treated with the described tanning-liquors, in solutions containing vegetable tannin.

After the skins have been removed from the solutions of fat, paraffine or rosin, the leather intended for uppers and belts is greased in the same manner as leather tanned in the usual manner, with a mixture of tallow, train oil, or similar fat mixtures. After greasing, the fat is either fulled in or allowed to soak in by hanging the skins in a moderately heated room.

The upper leather is, generally speaking, curried in the same manner as leather tanned by the ordinary process, a few points only requiring special precautions to assure a fine product.

In preparing black grain leather, it is best to blacken the skins before placing them in the fat solutions. For blacking, on account of the yellow ground being more difficult to blacken, the application must be repeated once or twice oftener than for leather tanned in the ordinary manner.

If the leather is to be blackened after greasing and currying, the fat must first of all be thoroughly removed by scouring with dilute solution of soda or ammonia, and rubbing with pumice stone powder, or wood ashes. The grain side thus cleansed is then blackened with logwood extract or iron black.

Sole leather tanned by the above process, is, after removal

from the tanning-liquor, impregnated with solutions of fat, wax, or rosin. It is then dried and rolled.

In working the upper and sole leather into shoes, the following directions should be observed: In order to be able to last the upper well, it should be placed in lukewarm soap-liquor for 10 to 12 hours and frequently kneaded. Lasting can only be accomplished in the ordinary manner after the fluid has thoroughly permeated the grain, which is more difficult to effect than with leather tanned in the usual manner. Chromium leather it is claimed is more water-proof. The property of the leather of not stretching after having been worked, deserves special attention, since a shoe made a close fit, as is generally the case with leather tanned in the usual manner, is apt to be too tight.

For sole leather to be easily worked it is not sufficient to dip it simply in cold water; it should remain for some time in lukewarm water.

As will be seen from a table on p. 88, experiments which have been made in regard to the absorption of water by leather tanned in the usual manner and that prepared with chromates, have shown that the latter absorbs water slower and a smaller quantity of it than the former.

A further advantage of chrome leather is that it possesses the property of losing less tannin by repeated treatment with cold or warm water than leather tanned in the usual manner.

We give here comparative experiments as regards the solubility of the tannin in chrome leather which were made by Dr. J. Clark, city analyst of Glasgow.

In order to establish the total quantity of chromium contained in the leather and also the quantity of chromium which was under different conditions withdrawn by the action of water, he used six samples of chrome leather, namely: Foreign bends; English bends; heavy sole leather; strips of sole leather; bullock leather, and calf leather. The samples were cut into pieces of two inches square, and the resulting percentage of chromium calculated as potassium bichromate as follows:—

Total percentage of chromium calculated as potassium bichromate: Foreign bends 3.30 per cent., English bends 3.47 per cent., heavy sole leather 3.97 per cent., sole leather strips 4.80

per cent., bullock leather 6.18 per cent., calf leather 3.50 per cent.

The quantity of potassium bichromate withdrawn was as follows:—

a. By boiling with water for half an hour:—

Foreign bends, 0.005 per cent.; English bends, 0.048 per cent.; heavy sole leather, 0.006 per cent.; sole leather strips, 0.018 per cent.; bullock leather, 0.054 per cent.; calf leather, 0.006 per cent.

b. By immersion in cold water for 12 hours:—

Foreign bends, 0.004 per cent.; English bends, 0.019 per cent.; heavy sole leather, a trace; sole leather strips, 0.006 per cent.; bullock leather, 0.022 per cent.; calf leather, 0.060 per cent.

c. By immersion in cold water for 24 hours:—

Foreign bends, 0.005 per cent.; English bends, 0.027 per cent.; heavy sole leather, a trace; sole leather strips, 0.007 per cent.; bullock leather, 0.043 per cent.; calf leather, 0.077 per cent.

d. By immersion in cold water for six days:—

Foreign bends, 0.014 per cent.; English bends, 0.091 per cent.; heavy sole leather, 0.025 per cent.; sole leather strips, 0.017 per cent.; bullock leather, 0.135 per cent.; calf leather, 0.123 per cent.

A sample of good leather tanned in the usual manner and obtained from one of the best English tanners on being treated in the same way gave the following results:—

a.[1] Withdrawn by boiling in water for half an hour=2.13 per cent. (containing 0.77 per cent. of tannic acid).

b. By immersion in cold water for 12 hours=2.99 per cent. (containing 1.08 per cent. of tannic acid).

c. By immersion in cold water for 24 hours=4.45 per cent. (containing 3 per cent. of tannic acid).

d. By immersion in cold water for 6 days=6.79 per cent. (containing 2.55 per cent. of tannic acid).

[1] That less extraction occurred by boiling than by immersion in cold water for 12 hours is probably explained by the fact that by boiling a part of the skin substance is converted into glue, which forms an insoluble precipitate with the tannic acid.

From the above results it will be seen that the quantity ot potassium bichromate extracted by immersion of chrome leather, even if continued for 6 days, is exceedingly small, and this quantity, small as it is, is in all probability still further decreased by the reducing action of organic substances upon the chromic acid.

Dr. Clark concludes his report as follows: "I am firmly convinced that the remainder of the chromic salts cannot be withdrawn from the leather by any influence to which it may be exposed in use."

We give in the two following tables the results of two English experimental stations as to the stretching capacity of chrome leather and tan leather.

	Designation.	Dimensions of the sample.			Breaking load.		Weight.			Comparative results.	
		Width.	Thickness	Surface.	For the whole.	Per sq. inch.				Stronger by	Weaker by
		Inches.	Inches.	Sq inch.	Tons.	Tons.	Ozs.	Dr.	Gr.	Per cent.	Per cent.
573	Tan leather, English Bend . .	3 92	0.240	0.940	1.3750	1.462	6	9	8	...	15
574	Chrome leather, English Bend . .	3.92	0.220	0.862	1.2750	1.479	5	14	14	15	
575	Tan leather, Foreign Bend . .	3.92	0.235	0.921	1.1375	1.235	6	4	11	...	11
576	Tan leather, Foreign Bend . .	3.92	0.230	0.901	1.4500	1.609	6	6	8		
577	Chrome leather, Foreign Bend . .	3.92	0.200	0.784	1.6625	2.120	6	12	7	11	
578	Tan leather, Belt leather . .	3 92	0.195	0.764	1.3500	1.767	6	10	17		
579	Tan leather, Belt leather . .	3.92	0.255	0.999	1.5500	1.551	7	19	7	...	31
580	Tan leather, Belt leather . .	3.92	0.215	0.842	1.5000	1.780	6	7	11		
581	Chrome leather, Belt leather . .	3.92	0.230	0.901	1.8750	2 081	6	3	19	31	
582	Chrome leather, Belt leather . .	3.92	0.250	0.986	1.8000	1.825	6	17	21		

By comparing surface and weight the samples of chrome leather proved therefore 11.15 and 31 per cent. stronger than those of tan leather. The compilation of the comparative results is based upon an equal weight of the separate samples.

(Signed) WILLIAM FRASER, *Director*.

Results of Experiments to determine the Stretching Strength of Six Pieces of Chrome Leather and Six Pieces of Tan Leather.

Dimensions. Inches.	Surface. Square inch.	Greatest load for the whole. Pounds.	Greatest load per square inch. Pounds.	Load per inch in width. Expansion 25 inches. 200 per cent.	400 per cent.	600 per cent.	800 per cent	1000 per ct.
CHROME LEATHER—				Stretching limit.				
8 by 0.28	2.240	7.378	3.297	8.48	14.44	18.72	22.92	
6 " 0.26	1.516	5.629	3.608	6.48	11.28	16.84	21.92	
5 " 0.25	1.250	4.716	3.772	9.68	13.00	18.88	22.72	
4 " 0.26	1.040	4.364	4.196	8.20	13.56	16.84	20.64	23.96
3 " 0.25	0.750	2.992	3.989	7.12	12.68	18.68	24.16	
2 " 0.22	0.440	1.774	4.031	5.92	12.52	17.96	22.20	
On an average		4.777	3.815	7.6	13.04	17.99	22.43	
TAN LEATHER—				Stretching limit.				
8 by 0.25	2.000	5.344	2.672	5.82	9.28	13.68		
6 " 0.19	1.140	3.708	3.252	5.80	9.52	13.64		
5 " 0.23	1.150	4.459	3.877	4.72	7.68	11.44	15.40	
4 " 0.20	0.800	3.283	4.103	4.80	7.76	11.32	15.12	
3 " 0.20	0.600	2.156	3.593	4.32	7.20	9.96		
2 " 0.21	0.420	1.661	3.594	3.36	6.08	8.40	11.12	
On an average		3.455	3.575	4.72	7.92	11.41	13.88	

The thickness of the pieces being unequal, each piece was measured on six different places, and the mentioned dimensions are those at which the break occurred.

LONDON, S. E., November 8th, 1880. (Signed) DAVID KIRKALDY.

The foregoing statement indicates: 1st. that chrome leather excels in strength; 2d, that after reaching the stretching limit with a corresponding load, it possesses still a considerable degree of elasticity which is of great value as regards the adhesion of belts to pulleys.

Aluminium Tanning.

This patented method of tanning originated with Dr. Putz, of Passau. The skins are prepared in the usual manner and then completely tanned with a solution of aluminium sulphate or common salt. After tanning, the tannin, it is claimed, is precipitated upon and fixed in the skin by fulling in an insoluble precipitate produced by boiling hair, horn, blood, and other substances containing albumen, with a solution of potash or caustic soda, and precipitating the resulting solution with aluminium sulphate or other aluminium salts.

List of all Patents for Employing Mineral Substances for Tawing Hides and Skins, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
17,955	Aug. 4, 1857.	H. Hibbard,	Henrietta, N. Y.
21,168	Aug. 10, 1858.	T. Klemm,	Pfullinger, Germany.
46,443	Feb. 21, 1865.	G. Bottero,	Boston, Mass.
86,506	Feb. 2, 1869.	F. Clozel,	Paris, France.
159,366	Feb. 2, 1875.	W. R. Stace,	Rochester, N. Y.
193,520	July 24, 1877.	F. Knapp,	Brunswick, Germany.
193,521	July 24, 1877.		
231,797	Aug. 31, 1880.	C. Heinzerling,	Biedenkopf, Germany.
238,389	Mar. 1, 1881.		
260,322	June 27, 1882.	C. Richter,	St. Paul, Minn.
260,418	July 4, 1882.		
281,411	July 17, 1883.	C. P. Smallridge, Sr.,	Catlettsburg, Ky.
287,255	Oct. 23, 1883.	F. E. Dietsch,	Woodbury Falls, N. Y.

Note.—For a portion of the matter in this chapter the author desires to acknowledge his indebtedness to Heinzerling's Lederbereitung, Bolley's Technologie, 35 (Bd. vi. 4).

CHAPTER XLII.

TAWING—FRENCH OR ERLANGER METHOD OF TAWING—DANISH GLOVE LEATHER—JENKINS'S METHOD OF TAWING—DEFECTS OF ALUMED VARIETIES OF LEATHER—MANUFACTURE OF OIL OR CHAMOIS LEATHER—PRELLER'S METHOD OF TAWING—KLEMM'S OIL LEATHER.

French or Erlanger Method of Tawing.

The manufacture of soft leather for gloves, *i. e.*, the so-called *French* or *Erlanger* leather, which was originally a French industry, has also been lately brought to a high degree of perfection in Germany and Austria, and especially in Prague. As these varieties of leather are intended for articles of fashion and luxury, they require all the properties of alumed leather in a higher degree, according to whether the articles manufactured from them are to be a pure uniform white, or a light delicate color. These demands can only be fulfilled by using the most scrupulous care in preparing the skins, great cleanliness, and avoidance of anything which might cause stains, such as the use of vessels of oak, water containing iron, etc. It is besides necessary that the gloves should possess a more than ordinary capacity of stretching, and a high degree of suppleness, while they must at the same time be strong and durable, and the grain sound and free from all injury. They must further adapt themselves to the hand, and by their capacity for stretching supplement the natural inaccuracies of the pattern, and, what is the most difficult to avoid with such tender skins, not tear in the seams or the leather.

The utmost care in working the raw material alone will therefore not suffice, since the quality and availability of the leather will largely depend on the quality of the skins.

Besides conducting the tawing process with care and cleanli-

ness, a manufacturer who desires to bring into the market an article answering all demands, should therefore know how to select and buy the skins to be worked.

We will therefore, before treating of the tawing process itself, give a few practical hints as regards the buying and storing of skins intended for glove leather.

Buying and Preserving the Raw Skins.

The skins most generally used for the manufacture of glove leather are those of lambs and kids, together with a few other light varieties such as skins of chamois, dogs, etc. The skins of unborn, or at least very young lambs, which are brought into commerce principally from England and Hamburg, furnish an especially fine material for glove leather.

Generally speaking, kid-skins are preferred to all other varieties, as they furnish a more tender and a finer variety of leather than all others, with the exception of chamois-skins, which are also very highly esteemed. Skins of young lambs, especially of those not more than one month old, give also a very good and flexible leather, though this is not the case with old skins, which can therefore be only used for the manufacture of an inferior quality. Kid-skins being comparatively rare, skins of young lambs, the Silesian and Spanish being preferred to the Hungarian, Servian, etc., are almost exclusively used for the manufacture of glove leather. Large quantities of lamb-skins have also been recently imported from South America, especially from Buenos Ayres, which, though equal in quality to the Hungarian skins, are inferior to the Silesian and Spanish articles. As regards dog-skins and cat-skins, which are less frequently used, much depends on the age of the animal, and the breed.

A kid-skin should, in order to be classed as a commercial article, measure at least 10 to 10½ inches square; of the smaller skins three are generally counted for two, or even two for one.

As regards lamb-skins, those from long-wooled species are the best. The skins of half-blooded breeds have but little value for the manufacture of glove leather, and those of full-blooded stock none whatever, as they are usually very thin and porus, and have but little strength, on account of the epidermis

being generally imperfectly connected with the true skin. The great difference in the quality of these skins is partly due to the sheep themselves, and partly to the food. It may, however, be laid down as a general rule, that the coarser the wool the better the skin for the manufacture of glove leather.

By crossing he-goats and ewes a bastard breed is obtained, the skin of which, though bearing wool, approaches that of kid, and furnishes good material for glove leather.

The price of lamb-skins, which varies very much, depends largely on the quantity and fineness of the wool, and the size and quality of the skin itself.

After the lambs or kids are weaned, and commence to eat other food, the skin gradually loses more and more of its beauty and suppleness, and consequently its value for glove leather. The skin of a lamb fed partly on the milk of the mother and partly on other food, loses comparatively little in quality. A good skin should be smooth and lustrous, and slightly transparent without being too fat.

After procuring the required stock of skins, the tanner proceeds to sort them according to derivation, size, and age. A large stock of skins should never be stored away without previous sorting, since, after a lapse of time, it will not be possible to tell accurately the age of a skin nor its derivation, while it is of the utmost importance for the production of good leather to use for any tawing process only skins as uniform as possible.

The skins, after sorting, are stored in a dry and airy loft or shed. While stored they are exposed to many dangers, especially during the hot season of the year. Among the principal injuries to which skins are subjected while stored, we may mention such as arise from heating and the attacks of moths.

Heating, to which kid skins are especially exposed, is actually nothing but the appearance of a superficial putrefaction attended, in consequence of the skins being closely piled, by a more or less strong heating which materially promotes the decomposition already commenced. As skins not entirely dry before storing are principally affected by this evil, special attention must be paid to the thorough drying before piling upon

each other. But even with entirely dry skins, the tanner should assure himself from time to time, by an examination of the separate ones, that heating has not made its appearance, and to stop the evil immediately, in case he finds the slightest indication of it, by spreading the respective skins in the sun or in a dry and airy place. Although a slight heating of the skins, such as is frequently observed during damp weather, effects no material injury, too much of it will certainly cause considerable damage. Heating renders them soft, spoils the grain, and causes the wool to fall out. Although these injuries may frequently not be observed at once, they will be only too plainly perceived in the after-treatment of the skins.

The damage by moths is caused by the deposits of larvæ of certain moths in the wool of the skin.

From the middle of spring to the end of summer small, silver gray butterflies are observed, especially in the evening, flying around in the houses. These are the genuine moths appearing most frequently in July and August. These nocticidæ take no nourishment and possess no weapon with which they could cause damage. Their only object is to form a sexual union, and this being accomplished the female lays its eggs upon clothing, furniture, etc., but preferably upon wool or fur. The eggs are so small as to be scarcely perceptible with the naked eye. The larvæ make their appearance in a few weeks, sooner in warm weather than in cold. Only the eggs and larvæ can stand the cold of winter.

Although the moths themselves are generally known, this is not the case with the larvæ, as they live in hidden places and are so small and insignificant as to escape observation. It may, therefore, not be inappropriate to give here a short description of these enemies of wool. The extremely small grub of the moth, which externally does not differ materially from other larvæ, is provided on the forepart of the body with three pairs of horny feet, which together with the mandibles and a part of the scutellum, form the only horny part of the body. The first business of the grubs after emerging from the eggs is the construction of a cocoon. For this purpose they weave first a thick, spindle-shaped tube around their centre, and enlarge this tissue,

consisting of delicate silk-like threads, by biting off with their mandibles the hair of the wool or fur surrounding them, and attaching them with a sticky substance secreted by them. This cocoon, which is open on both ends, has the same color as the wool or the hair of the skin, or the tissue in which the grub lives. In the same degree as the grub grows, the cocoon becomes too short and narrow. When this is the case the grub projects the fore-part of its body from the cocoon and, after biting off with its mandibles the wool or hair within reach, and enlarging the cocoon on that end by gluing the wool to it, turns around and performs the same operation on the other end. To widen the cocoon the grub gnaws through the entire length and inserts a new piece by gluing in wool or hair. When the grub has nearly attained its full growth, and the time of metamorphosis approaches, it leaves its place of concealment and moves into the open air where, after attaching one end of the cocoon to a wall, woodwork, etc., it changes to a chrysalis. The perfect moth emerges after three weeks, during which time the chrysalis does not leave its place of abode. While the grubs of the genuine moth carry their cocoon with them, there are others, for instance, the *ascarides*, which build permanent cocoons in the form of passages of greater or less length on the base of the fur in which they live. The damage done to the skins by these insects not only consists in the destruction of the wool, which would be of little consequence, but in injury to the skin itself by the perceptible traces they leave upon it which damage the grain and quality of the leather.

The best means of getting rid of these insect pests is to air the skins every eight or ten days during the hot summer months, and, if possible, beating them thoroughly in order to remove any larvæ already in the wool. In cold weather beating every three or four weeks suffices. To be successful it is not sufficient to beat the bales, but each skin must be handled separately. To avoid this work which, though sure, is very tedious, many preservatives have been recommended, for instance, placing powdered pepper, the blossoms of Roman camomile, leaves of patchouli, etc., between the skins, or sprinkling them with carbolic acid, spirits of camphor, etc., or scattering insect-

powder or sumach upon them. The best of these means, none of which is entirely effective, is perhaps carbolic acid or a mixture of birch oil and camphor, but they impart to the skins a penetrating odor which is not lost even by the succeeding treatment, and can only be got entirely rid of by long continued airing.

Manner of Working the Skins.

The principal difference between the ordinary and French method is in the actual tawing process and the means used to accomplish it, the preparatory labors being in the main the same.

The work of tawing leather according to the *French* or *Erlanger* method is divided as follows:—

1. *Soaking and Rinsing.* 2. *Liming and Depilating.* 3. *Treating with bate.* 4. *Handling in the bran vat.* 5. *Tawing in the tawing compound.* 6. *Finishing.*

1. *Soaking and Rinsing.*

As previously mentioned, it is of great advantage for the manufacture of good glove leather to work skins in as nearly the same manner as possible, in order to obtain a nearly uniform product. This should be taken into consideration at the commencement of the work by soaking skins as nearly alike as possible and their differing not too much as regards age. Soaking and rinsing are effected either in running water, or if possible in the "soaks." The soaking is continued until all the skins are uniformly soft and freed from adhering dirt and blood, and thoroughly cleansed on the flesh side as well as on the wool side. In order to obtain clean wool, which is more salable, the wool side is frequently scrubbed with soap, though this labor is of course omitted in handling very young lamb-skins, the wool of which has no commercial value.

In soaking and rinsing, special care must be had to have the water free from impurities, especially mud and iron, and not to use vats of oak, but of soft wood. In regard to the duration of soaking we will state that, as the skins of young animals, such as kids and lambs, have to be chiefly taken into consideration,

three days in winter, and at the utmost two days in summer should suffice for the process.

After soaking and rinsing the skins are subjected to the breaking process, which is effected in the same manner and with the same tools as in ordinary tawing. A clean beam and a fleshing knife free from rust, and not too sharp in order to avoid injury, are required. In breaking the skins their great tenderness and susceptibility to injury must be taken into due consideration.

After breaking and another rinsing, the skins are ready for depilation. In most places this is proceeded with at once, while in some taweries the skins are placed in bate for two to twenty-four hours to make them more susceptible to the action of the lime and accelerate the loosening of the hair.

2. *Liming and Depilating.*

It is usual to consider 13 to 15 pounds of thoroughly burned limed, slacked to milk of lime, as being required for 100 goat-skins, or equally large lamb-skins. The process of liming is conducted either by using several lime-vats with lime water of different strengths, and putting the skins successively from the weakest lime-vat into the strongest, or what is more generally the case, by employing but one lime-vat and increasing gradually the concentration of the lime water. For the latter purpose the entire quantity of lime to be used is generally divided into four equal portions, and the lime-vat, which is generally filled with lime water previously used, is charged for the first liming with one quarter of the entire quantity of lime.

After thorough stirring throw each skin separately into the vat so that it falls with the wool side down upon the surface of the milk of lime, and push down with a pole.

In this vat the skins remain, according to size and age, for one to three days, though in winter they are generally allowed to remain somewhat longer. The skins are then lifted out with wooden tongs—iron tongs must be absolutely forbidden—and hung upon the edge of the vat to drain off.

After preparing milk of lime from a second quarter of the lime, with the avoidance of too great an excess of water, and

adding this to the lime-vat, the skins are replaced in such a manner that those previously on the top come now on to the bottom. The skins after remaining in this vat for two to four days according to the season, are taken out and allowed to drain off. After converting the third portion of the lime into milk of lime and adding this to the vat, the skins are replaced. After 4 days they are again taken out, allowed to drain off, and replaced after adding the milk of lime prepared from the last portion of the lime. In this vat the skins may remain 6 to 8 days, but must be handled every 24 hours and replaced in reverse order. During this time the skins should be frequently examined, and those, where the hair or wool is found to yield, removed.

After removal from the lime-vat and rinsing in clean water, the skins are placed in clean water and depilated successively, and after depilation thrown into a vat filled half full of water.

In depilating the greatest care must be observed to avoid injuring the grain by too strong pressing, and to be able to do this, the skins should not be taken from the lime-vat until the hair or wool is thoroughly loosened.

The method above described is principally employed for kid- or young lamb-skins. Frequently a mixture of orpiment and lime, or of gas-lime and lime, is used for loosening the hair.

For depilating the skins of older animals, especially those over a year old, the sweating process previously described is generally employed. But in order to yield supple leather such skins must, after depilation, be placed in the lime-vat for 3 to 4 days. The skins are then topped or docked, and, after breaking them upon the beam and cleansing, are thrown into a vat filled with water. To prevent the skins from becoming spotted, they must at no time be allowed to remain long out of water.

3. *Treatment in Bate of Dog Excrements.*

This work is frequently connected with the so-called fulling, and sometimes entirely replaced by the latter. As regards the preparation and use of the bate we refer to what has been said about it under tanning, only calling attention to the fact that

the action of the bate must be shortened in accordance with the weaker texture of the skins.[1]

After removal from the bate, the skins are either at once broken and rinsed or first fulled. For the latter purpose 300 to 500 rinsed skins are placed in the fulling trough and pounded thoroughly with a rounded-off wooden mallet. After a quarter of an hour a bucketful of clean water is poured into the trough and the fulling continued for twenty minutes longer, when another bucketful of water is poured in and the fulling again continued for twenty minutes. The skins are then placed in a vat full of clean water for one to three days according to the season of the year.

The fulling can also be effected with a washing wheel such as is frequently used by manufacturers of Morocco leather.

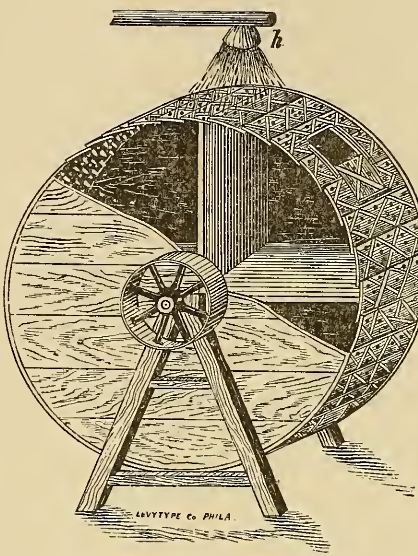
A washing wheel much used in Germany and France is arranged in the following manner: A wooden drum, with a diameter of ten feet and a width of rim of three feet four inches, lies with its horizontal axis in brass boxes, and motion is imparted by means of a crank or driving gear. The drum is shown in Figs. 294 and 295, and the interior is divided by partitions into three or four compartments in such a manner that each compartment is accessible from the exterior through a large aperture, *d*, in the rim of the drum, which serves for the introduction of the skins and can be closed with the slide *i*. Short cross ribs projecting towards the centre are arranged on the arch of the compartments, *i. e.*, on the inside of the rim, which is perforated with fine holes. The outside of the rim is provided with small laths nailed on zig-zag. The object of these, and of the laths on the edges of the rim, is to prevent as

[1] In most taweries the bate is generally prepared by soaking dog excrements in water and stirring them to a uniform paste, of which $2\frac{1}{2}$ to $3\frac{1}{2}$ gallons mixed with a sufficient quantity of water of 95° F. are used for 1000 young lamb-skins. The depilated skins remain in the bate for about 3 hours, or at the utmost until the remnants of flesh can be readily detached. The skins suffer injury by remaining too long in the bate.

We would here call attention to the fact that dog excrements are frequently adulterated with human excrements. The tanner should be very careful in regard to this, since the abundance of bilious coloring matter in human excrements is apt to cause the finished leather to be spotted.

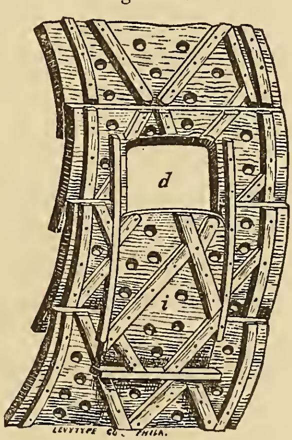
much as possible a waste of water falling from the rose *h*, which is placed above the drum.

Fig. 294.



The manner of using the drum for fulling is as follows: The drum, after placing the skins in the different compartments and closing the slide, is set in motion and water allowed to fall continually through the rose upon the rim of the drum. The manner in which the machine works is self evident. The skins in the compartment occupying the lowest position during the revolution of the drum lie upon the arch, *i. e.*, the inside of the rim provided with projecting ribs. They remain here until by the upward movement of that part, they fall, by gravitation, towards the interior upon one of the partitions, and by the downward movement back upon the arch. By

Fig. 295.



this continual falling backward and forward, the skins are subjected to an action having the same effect as a gentle beating. During the upward movement they are at the same time constantly washed by fresh water falling into the drum from the rose, while the dirty water runs off on the compartment attaining its lowest position. These operations effect mechanically a complete removal of the lime soaps and other lime combinations from the skins and wash them thoroughly, and assist materially the action of the bate, the object of which is to produce the same results chemically.[1]

After removal from the bate or fulling drum, the skins are scraped upon the grain side with a dull scraping knife, and then rinsed in clean water, the latter operation being more effectively accomplished by another treatment in the fulling drum. The next operation is to break them upon the beam by working upon the flesh side with a sharp fleshing knife in order to remove the last adhering remnants of flesh and fat tissue. They are then rinsed and finally scraped again upon the grain side, this being, if necessary, repeated after rinsing. Generally only heavy skins, especially goat skins, require this repeated scraping and fulling. Light skins, such as kid, and young lambskins, cannot stand, nor do they require, scraping twice, allowing them to remain only for a short time in the bate and fulling drum being generally sufficient. A thoroughly worked skin should, on being taken from the water, fold together like soft cloth, be elastic and at the same time tough and have a uniformly white or greenish-white appearance without spots. The next operation is—

4. *Branning.*

The bran menstruum by means of which the skins are raised and the last traces of lime removed from the skin tissue, in consequence of the free acids formed by fermentation, is prepared and used in a similar manner as in ordinary tawing. Due con-

[1] Many tawers add some soda to the water used for fulling the skins, or draw the skins, after removal from the bate of dog excrements, through a weak solution of soda.

sideration should be given to the great tenderness of the skins and great care exercised to prevent too much raising and possibly total destruction.

The bran used in preparing the menstruum should be as fresh and pure as possible, and especially free from sand and dust. For 100 medium sized skins, soak $2\frac{1}{4}$ pounds of bran in cold water, and let it stand 3 or 4 hours with frequent stirring. The water with a large part of the impurities floating upon the surface, or held in suspension, is then poured off. On to the washed bran pour as much water as will cover the skins to be treated, and, after thorough stirring, add 9 ounces of pure common salt.[1] In this steep the skins remain for 10 minutes when they are turned, and allowed to rest after securing their entire immersion by weights or cross-pieces of wood. The temperature of the menstruum should never sink below 50° F., nor rise much above 68° F. In the first case the temperature is raised by an addition of warm water, and lowered in the latter case by adding cold water.

Great care should be observed in not carrying on the fermentation too vigorously, and in preventing the appearance of a putrid odor, as otherwise the raised skins would easily suffer destruction. When sufficiently raised, the skins are taken from the liquor and washed in fresh water, or placed upon the beam and scraped upon the flesh side, the latter being especially preferable to mere washing in case the skins should be raised too much, it being possible to reduce this evil somewhat by scraping.[2] The next operation is—

5. *Tawing.*

The object of this operation is not only to taw the skins but to treat them at the same time with the oil required to make them supple, and subject them to the action of flour, which imparts to good glove leather its characteristic fulness and softness. The tawing paste generally used consists of a mixture of

[1] In many taweries this is omitted.

[2] We would here remark that many tawers, in case they have treated the skins with a bate of dog excrements, do not use this bran steep.

solution of alum and common salt with yelk of egg and fine wheat flour. The following recipe for its preparation may be especially recommended:—

For 100 medium sized skins dissolve $1\frac{1}{2}$ pounds of common salt, and $5\frac{1}{2}$ pounds of alum entirely free from iron, in 9 pounds of boiling water. Then make a paste by stirring gradually into $14\frac{1}{2}$ pounds of the best wheat flour, and a little cold water, the yelks of fifty fresh eggs. Knead the paste in small portions with a gradual addition of water, until it has become thinly liquid; the formation of lumps need not be feared when brought in contact with more water. Then add 9 pounds more water to the paste, stirring constantly and vigorously, and finally mix it with the hand-warm solution of alum and common salt. The skins are then placed in a vat, and after pouring the lukewarm paste over them, worked thoroughly with the hands to moisten them uniformly. When this is done a thorough penetration of the paste into the skin tissue is effected by a workman with bare feet stepping into the vat and treading the skins slowly but vigorously by alternate raising of the feet. This treading, for which no suitable mechanical appliances have thus far been invented as a substitute, is continued until the skins have absorbed most of the paste, which for thin skins will require 1 to $1\frac{1}{4}$ hours and for thicker ones about 2 hours. The vat is then covered with a clean cloth, and, after allowing the skins to rest for 12 to 14 hours, the treading is repeated in order to make them thoroughly smooth and supple. To promote uniform treatment it is recommended to turn the skins occasionally during the treading, and, to secure uniformity of the product, it is not advisable to subject more than 500 skins to the process at one time.

After the second treading, during which it is customary in some places to pour off the remainder of the tawing liquor and replace it by lukewarm water, the skins are allowed to rest for a few hours, and are then stretched before drying. The object of stretching is to effect a uniform extension of the skins, which by the treatment in the tawing paste have become somewhat wrinkled. Two workmen, standing opposite to each other, take hold of each end of the skin and, after folding it grain side in,

stretch it as much as possible lengthwise. For drying, the stretched skins are suspended on poles, or fastened to strings by means of pins in such a manner that they hang free for almost their entire length. The latter method is preferable, as in the first the portion of the skin lying upon the pole will almost always turn out somewhat thicker, and besides become easily spotted in dyeing in consequence of the tawing paste piled up in these places. The principal point in drying is to effect it as quickly as possible, and for this reason the skins should be hung up in airy lofts which can be heated in damp weather. Skins drying slowly spot easily, or acquire a reddish shade difficult to remove.

Instead of the yelk of egg many tawers use olive oil as an addition to the tawing paste. This gives also a very supple and soft leather, provided the workman understands how to divide the oil very finely and to mix it intimately with the tawing paste. This is done by rubbing together in a mortar, such as druggists use, 2¼ pounds of the best wheat flour with sufficient water, or still better, thin gum mucilage, to form a stiff paste. Add to this drop by drop and very gradually, and stirring constantly with the pestle, 10 ounces of the best olive oil, and rub the mass until a sample mixed with a little water separates no globules of fat after continued standing. The mass, the preparation of which is rather tedious, prepared in the above proportions contains an equivalent of about 100 yelks of eggs, and is mixed with the tawing paste in the same manner. A still more perfect emulsion is prepared by stirring gum arabic finely pulverized, instead of wheat flour, into a thick paste with water, and adding to this the oil with constant stirring and rubbing.

About 1½ pounds of gum arabic will suffice for 9 ounces of oil. The use of this substitute for yelk of egg, though quite profitable, can only be recommended for inferior qualities of leather, and can only be rendered harmless by treading the skins a second time in clean water in order to remove the adhering gum substance, which otherwise would injure the softness of the leather in drying.

Another mixture suitable for a substitute for yelk of egg, which is sometimes difficult to procure, can be prepared by

mixing intimately $8\frac{1}{4}$ ounces of fresh almond oil, $8\frac{1}{4}$ ounces of fresh caseïne (such as is brought into the market under the name of curds), $12\frac{1}{2}$ ounces of dextrine, 1 ounce of borax. The mixture is effected by putting the caseïne in a stone-ware mortar and pouring over it the borax dissolved in as little boiling water as possible. After placing the mortar in a warm place, the hot mass is rubbed together until the caseïne is almost dissolved and a tenacious liquid drawing threads is formed. To the borax and caseïne then is next added, with constant rubbing, the pulverized dextrine, and after forming a uniform paste, the almond oil is added, drop by drop, and the rubbing continued until after about three-quarters of an hour the oil has been thoroughly mixed. The paste thus obtained can be diluted by slowly adding water, and the previously prepared wheat flour kneaded with it. A mixture of the above proportions answers as a substitute for 100 yelks of eggs, and can, as has been proved by many experiments, be used for the finest qualities of leather.[1]

Besides the above, many other substitutes for yelk of egg are used, and have been recommended.

In Parisian taweries calves' brains, intimately mixed with wheat flour, are used as a substitute for yelk of egg, $\frac{1}{3}$ oz. of brains being generally allowed for 1 yelk of egg. The brains of sheep and even of cattle are also used for this purpose, they being the more available the younger the animals from which they have been derived. In using such brain substance, it is recommended, in order to remove the bloodvessels, to rub it through a wire sieve with fine meshes, or to press it through large cloths.

According to Knapp, paraffin also furnishes an available substitute. He uses crude paraffin oil intermixed with crystals of paraffin. This, after heating until the crystals dissolve, is rubbed to an emulsion with starch-gum, and the resulting mixture compounded with salt, alum, and flour. This tawing paste imparts, it is claimed, a beautiful grain to the leather and sufficient stretching capacity.

[1] In using this mixture it is recommended to substitute for the alum in the tawing paste a corresponding quantity of aluminium sulphate.

In many taweries it is customary to substitute oil for a part of the yelk of egg by using about 2 tablespoonfuls of olive oil for each 20 yelks of eggs. In this case an intimate mixture of the yelk of egg with the oil, which can be easily effected by adding some flour, is absolutely necessary, as otherwise the spotting of the leather can scarcely be avoided.

In regard to the object of using a tawing paste such as plays a prominent part in the manufacture of French glove leather, the two never wanting constituents, alum and common salt, fulfill the same functions as in ordinary tawing, *i. e*, the alum is the actual tawing substance, while the effect of the salt is to promote the endosmose. But what effect do the yelk of egg and the flour produce?

Every practical tawer knows that the object of the yelk of egg is to impart suppleness to the leather, and there can be no doubt that it fulfills the purposes. Researches have shown that 100 parts of yelk of egg contain—

Water	48.4	parts by weight
Albumen	20.6	" "
Yellow oil of egg . .	31.0	" "
	100.0	" "

As neither water nor albumen possesses the power of imparting suppleness to leather we must assume that the fat contained in the yelk, *i. e*, the oil of egg, is the effective agent. From the fact that yelk of egg has been shown to be decidedly the best means of obtaining supple leather, we might naturally come to the conclusion that the oil of egg is, on account of its constitution, especially adapted for this purpose, or possesses properties not belonging to other oils. But this is by no means the case, and from the possibility of substituting other suitable mixtures for yelk of egg, it is clear that other fats properly prepared and used produce the same effect. The valuable qualities of yelk of egg are not found in a special constitution of the oil of egg, but are based upon other causes. We have already laid stress upon the fact that in preparing Erlanger or French leather it is absolutely necessary to have the fat finely divided before bringing

it in contact with the leather. Fats mix with aqueous fluids with difficulty or not at all, and after an artificial mixing has been effected, a separation of the fat from the aqueous fluid will sooner or later take place. For producing a permanent mixture of fat with an aqueous solution, the latter must possess the property of preventing the union of the small globules of fat suspended in it without changing the constitution of the fat itself.

This property is especially possessed by ropy and thickly fluid liquids, and for this reason it is possible to give water to a certain degree the power of mixing intimately and permanently with fat by adding gum and similar bodies, and also albumen, etc. But such artificial emulsions are not entirely permanent.

Though gum mucilage, albuminous fluids, etc. render the running together of the globules of fat more or less difficult, they do not prevent it entirely, since the fat divided in such artificial emulsions separates from it after long standing. But this is not the case with yelk of egg which contains the fat in microscopically small globules enveloped in a film of albumen. As long as the envelopes are not removed or broken by artificial means, a union of the globules of fat is not possible, yelk of egg being therefore a natural and very complete emulsion of the oil of egg in an albuminous mass, which can be diluted with water without destroying the films enveloping the separate globules of fat.

Independent of any other advantage the yelk of egg possesses that of being very convenient, since every other fat to be used for the same purpose requires tedious and time-consuming work for its fine division, while the former offers an emulsion ready made by nature. Having shown the advantages of the use of yelk of egg, it still remains for us to answer the question: What is the object of introducing fat into the skin tissue, and what effect does its presence produce upon the tissue of the leather?

By assuming leather to be a skin tissue the fibres of which have lost all power of adhesion, and designating such leather as supple in which an easy shifting and moving of the tissue fibres, which are liable to friction on many points, are accomplished, the signifi-

cation of fat in the tissue will be clear. The fibres, on the one hand, are rendered supple by the fat enveloping them, and, on the other hand, the friction produced by the moving and shifting of the fibres is reduced to a minimum by the intermediate layers of fat. By the word "*fat*" we should of course not understand an unaltered substance, but rather the products of decomposition gradually formed by the action of atmospheric oxygen.

Independent of the specific action of the fat oil contained in yelk of egg, it would seem that the albumen of the latter, besides serving as a means of division and a carrier of the emulsion, fulfills another function. This much seems to be proved by experiments of Knapp, who has shown that the precipitate produced by alum from solutions of albumen is easily and completely absorbed by the skin when kneaded with it, imparting to it a certain degree of tawing. According to this, the albumen contained in the yelk of egg would, on forming a combination with the alum or the alumina contained in it, pass into the skin tissue, and by depositing itself upon the separate fibres, assist not only in effecting a complete tawing, but increase at the same time the fullness and consequently the strength of the leather.

The attainment of a certain fullness seems, however, to be essentially the task of the third constituent of the tawing paste, viz., the flour. The opinion was formerly entertained, that the object of adding flour to the tawing paste was to obtain as white a leather as possible. But this is only true in an indirect sense, since the actual part the flour takes in the tawing process is an entirely different one. Independent of some constituents, which are of minor interest to us, we have only to consider the more prominent constituents of flour, *i. e.*, the starch and so-called gluten. Of these, starch, a hydrocarbon found in small white granules in the cells of plants, is well known.

Gluten being less known, we will mention here, that by this name is designated a constituent of the seeds of almost all varieties of grain, and it is a mixture of two albuminous bodies known as vegetable fibrine and vegetable glue. As, according to this, flour is a mixture of several bodies, the question we must propose is, whether all the constituents of the mixture take part in

the tawing process, or, if this is not the case, which are of the most importance.

The opinion was formerly generally entertained, that the availability of the flour depended on the starch, but at present there can be no doubt that the effect of the flour is due to the gluten. Knapp has shown by suitable experiments that leather tawed in a paste containing flour contains no starch whatever, but that the combination of the gluten, or, as previously mentioned, of albuminous substances in general, with the alumina of the alum, is absorbed by the skin and may even completely taw it. The action of the flour in the tawing paste is therefore easily understood.

The albuminous bodies in the flour combine with the alumina in the alum added to the tawing paste, and the combination thus formed is deposited, after passing into the skin, around the fibres of the tissue in the form of a loose voluminous precipitate, which, by augmenting the body of the separate fibres, imparts to the entire tissue a certain degree of fullness. Although the principal effect of the flour must, according to this, be attributed to the gluten, the starch is by no means an unimportant constituent.

Knapp, in his many experiments in regard to tanning and tawing, observed that certain combinations of alumina obtained as delicate voluminous precipitates by precipitating proteids with alum, form lumps when an attempt is made to knead them into the prepared skin and lose their capacity of penetrating into the skin tissue. To overcome this evil, the presence of another indifferent body is required which, by depositing its fine particles between the interspaces, prevents the particles of the combination from approaching each other and forming lumps. This is the part the starch has to perform, which, though it is not absorbed by the skin tissue, is capable of keeping the particles of the combination of alumina with gluten apart until they have penetrated the skin tissue and taken their proper position. This explains why flour cannot well be replaced by other means.

To recapitulate briefly what has above been said the object of the mixture of alum, common salt, flour, and yelk of egg or

its substitutes is, besides tawing, which is due to the alum and the common salt, to impart softness and suppleness to the leather and finally fullness, the yelk of egg serving specially the purpose of obtaining suppleness and the flour fullness.

After treating with the tawing paste and drying thoroughly, the leathers can be stored without danger in a dry place. They require only

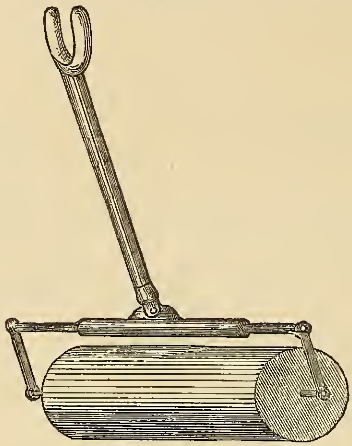
6. *Finishing*,

the object of which is, on the one hand, to remove the last remnants of adhering tissue fibres, and, on the other, to impart as high a polish as possible and a delicate smoothness to the leather. The first operation is stretching the moistened leather. For this purpose the skins are sprinkled separately with water, and after stretching evenly upon a level table, they are piled upon each other and allowed to lay for some time until they are uniformly moist. About 12 to 15 of these moist skins are then piled upon a linen cloth upon a straw mat, and after being covered with a clean cloth or a large skin especially kept for the purpose, softened by a workman treading them. Each skin is then subjected to stretching by a workman holding it distended by both ends and drawing the flesh side in every direction over the stretching iron in order to remove as much as possible all remnants of adhering tawing paste. The skins are then stretched on poles, dried, and, after repeating the treading and drawing over the stretching iron, rubbed upon the grain side with a soft woollen rag to remove any adhering flour. Skins which are to remain white, or to be dyed a light color, are frequently bleached by exposing them to the sun for several hours. This is not required for skins to be dyed dark. Although leather finished in this manner is ready for the market, it is frequently subjected to glazing. The object of this operation is to make the grain side as smooth as possible, it being sufficient for sound and thoroughly tawed skins to pass them through the smoothing roller, although in large factories special smoothing machines are used.

The polishing is generally accomplished with a polished steel or agate roller set in a crutch handle and revolving around its

axis, as shown in Fig. 296. After spreading the skin, flesh side down, upon a table with a smooth wooden or stone plate, the workman passes the roller repeatedly and forcibly over the grain side of the leather. By this operation any little irregular-

Fig. 296.



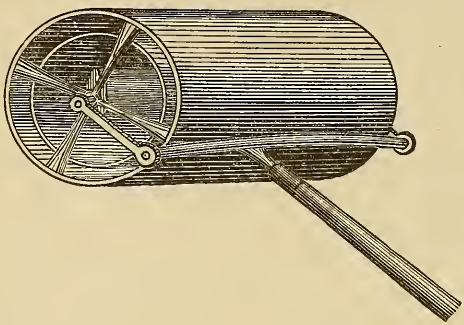
ities injurious to the appearance of the leather and making it feel rough to the touch, are removed from the grain side, and the leather rendered smooth and to a certain degree lustrous.

The same effect is produced by the use of a large polished glass or stone ball, although, as the workman has to guide the ball with the hand, and cannot exert as strong a pressure as with the smoothing roller, the process is tedious, and consequently less suitable. The use of heated rollers is very advantageous. For this purpose the steel rollers are heated either by placing them in boiling water or by means of a spirit flame, care being had not to heat them too much, as otherwise the leather might be burned or become wrinkled.

We had occasion to become acquainted with a polishing roller kept hot by a simple device, thus allowing the work to be carried on without interruption. The construction, as shown in Fig. 297, is as follows: In a hollow steel roller about four to six inches long and about two and a half inches in diameter fits exactly a piece consisting of two cross spokes connected by a shaft projecting on

both sides. To the spokes is fastened a sheet-iron cylinder of the same length as the roller, but about one-half inch less in diameter. Upon the perfectly round and polished shaft sits an oblong spirit lamp the wick of which can be regulated, and the

Fig. 297.



bottom of which, in order to keep the lamp constantly in a vertical position, is weighted with lead. A handle with branches for the reception of the ends of the shaft and with an upholstered crutch serves for guiding the apparatus. For working with such a polishing roller it is only necessary to regulate the flame of the spirit lamp so as to heat the roll adequately, the remaining work being the same as with an ordinary roller.

Instead of polishing rollers ordinary flat irons are employed in many small work-shops, the manner of using them requiring of course no further comment. As regards the construction of more complicated polishing and finishing machines, the use of which, compared with their cheapness, offers great advantages, we must refer the reader to the respective patents.

For inferior qualities of leather, especially such as are obtained from the skins of diseased animals, the operation of smoothing is frequently preceded by that of glazing, by spreading the leather upon a smooth table and applying a thin coat of white of egg, gum, or mucilage of gum tragacanth. In using white of egg for the purpose it is best to beat it first to a froth in the same manner as cooks do, and then add, with constant stirring, double its weight of water. By allowing the whole to stand in

a warm place for about twelve hours, an available solution of white of egg is obtained, which is applied with a soft brush, or, still better, a small clean sponge. The best proportion for gum solution is 1 part of gum to 8 to 10 of water. The leather after glazing is dried and finally polished with the smoothing roller.

Leather thus treated is known as glazed or *glacé* leather.

The above described method of preparing French or Erlanger leather, although the most common, is by no means the only one employed. Many methods differ, in fact, essentially from the one described, and, although they are, generally speaking, antiquated, and offer no material advantage, we will give a short description of them.

Aikins's method of working lamb-skins into glove leather is, according to Dr. C. H. Schmidt, as follows:—

After soaking the skins in water for some time to free them from adhering dirt, blood, etc., they are laid upon a beam covered with strong leather, and worked with the dull edge of a segmental scraping knife. A large number of them are then hung in a small narrow room heated by flues, and allowed to remain until an incipient putrefaction takes place. This is recognized by a strong odor of ammonia coming from the room on opening the door. The regular course of the putrefying process is recognized by a thick slime making its appearance upon the surface which loosens the roots of the wool so that it can be readily plucked from the pelt.

The skins are then *slimed*, that is, scraped upon the flesh side and stripped of the wool. They are then steeped in lime-water for a longer or shorter time, according to their condition. By this process further putrefaction is arrested and the skins considerably hardened and thickened. The skins are then worked upon the beam to remove the slime separated during liming, and cleansed and smoothed.

These operations require much labor and care. The skin must not be injured by too long-continued putrefaction, as this would convert it into a non-cohesive pulp. Besides, every particle of slime must be removed, as even the smallest remnant

would unfit the skin for further working and for the reception of the dye.

The skins are next placed in a vat filled with bran and water, where they remain for a time in a state of slight fermentation. The hardening and thickening produced by the lime are then removed by working the skins upon the beam and scraping them soft, by which the skin is actually converted into a thin, ductile, white membrane suitable for the succeeding operations.

The manner of treating chamois and goat-skins is nearly the same, except that the hair having no other value than for plasterer's use, the skins are limed before removing the hair. Chamois and goat-skins require, besides, a longer time for tawing.

When taken from the bran steep, the skins to be tawed white are put into a bath composed, for 120 skins of medium size, of a solution of about $3\frac{1}{3}$ pounds of alum and $4\frac{1}{2}$ pounds of common salt in warm water, where they remain until they have absorbed a sufficient quantity of the liquor. This operation re-imparts to the skins a certain degree of thickness and tenacity.

When taken from the *white bath*, the skins, after washing in water, are allowed to ferment in a bran steep for some time in order to extract a considerable portion of the alum and salt and reduce the thickening acquired in the white bath. The skins are next dried by stretching them on hooks in an airy room in the centre of which stands a stove. When dry they will be found converted into a tough, flexible, and nearly white leather. To glaze the latter and remove any remaining roughness, it is again soaked in water, losing an additional portion of salt by the process. The skins are then placed in yelk of egg compounded with water in a wide vat and trodden until they have gradually absorbed all the egg substance and the supernatant fluid is entirely clear. They are then dried in the air and polished with a flat iron.

As will be seen, the principal difference between this and the other method is that the tawing is effected with alum and common salt alone, while the treatment with yelk of egg, to which in this case no flour is added, is executed after the skins are

tawed. We doubt if this modification offers such considerable advantages as would justify the increased expense of labor and time. Another remarkable difference is that Aikins washes the skins after tawing in the white bath, and places them in a bath similar to the bran steep, in which they have to pass through a short fermentation. This treatment, the consequence of which, besides the reintroduction of raising, must be a retrogression in tawing, produces no doubt a tough leather, but leaves much to be desired as regards softness and suppleness. The method of depilating lamb-skins, the wool of which is to be utilized, used by Aikins, is nearly the same as the sweating process previously described, and requires no further comment. Watts's method of working the skins of lambs, goats, and dogs into glove leather differs from the ordinary process only in the separation of the treatment in the tawing liquor from that in the yelk of egg.

Schmidt describes this process as follows:—

Soak the skins in clear water for 24 hours, then place them upon the beam flesh side up, and remove the fibres with the fleshing knife. Replace the skins in water, best in the same previously used, for 12 hours. Then scrape again with the fleshing knife, and stretch them in a loft or room until a slimy substance appears upon the flesh side, which remove with the knife. Then suspend the skins in the sweating-room until the wool can be readily plucked from the pelt, and when this state is reached, place the skins upon the beam and remove the wool in the ordinary manner.

The depilated skins, after soaking in water for 5 to 6 hours, are dried and again placed upon the beam and scraped on the flesh side to remove all membranous substance, the neck and leg pieces being cut off at the same time.

The skins are next replaced in clear water for 5 to 6 hours to soften any dirt adhering to them, and then dried by placing them in a wicker basket for about half an hour. When dry they are placed in the warm alum bath ; but in case they are to be colored it must be done before placing them in the alum bath.

For 120 skins of medium size a solution of 12 ounces of ordi-

nary alum in about a bucketful of water is required. To dissolve the alum completely it is necessary to bring the liquor to the boiling-point, the temperature being afterwards reduced by pouring about one-half of the boiling liquor into the same quantity of cold water.

In the alum liquor the skins are kneaded with the hand for about a quarter of an hour. The remaining portion of the liquor is then added, and, after working the skins for a quarter of an hour longer, they are dried in a wicker basket.

When dry a workman treads the skins for a quarter of an hour in a blood-warm liquor, composed, for 120 goat-skins, of the yelks of 40 hen eggs and half a bucketful of water, and for 120 lamb-skins of the yelks of 30 hen eggs and the same quantity of water. After thoroughly absorbing the liquor the skins are stretched in the air to dry. When dry they are placed in a damp cellar for eight to ten hours. Finishing is effected in the usual manner.

We will finally describe M. Main's, of Niort (France), process of finishing alumed leather, which gives a very soft and ductile product. It is adapted to every variety of leather, provided it is strong enough, and, what is still more important, of a uniform thickness; but it may be especially recommended for leather not readily salable in consequence of the grain being not clean, or, at least, injured or spotted.

The *modus operandi* of the process is as follows:—

Place the closest and strongest alumed skins in warm water, and, after soaking thoroughly, put them upon a smooth beam covered with thoroughly washed, unfinished calf, sheep, or buck-skin. Then scrape the alumed sheep-skin or goat-skin as strongly as you would buck-skin or oil-tawed sheep-skin, continuing until all the membranous portions are removed.

The workman, after passing the tool over the entire surface, suspends the skin by the hind legs to two iron hooks for drying, or stretches it on a string. When dry, the skin is fulled and treated in the usual manner.

In case a skin becomes drawn together by too quick drying it is only necessary to moisten it slightly.

The skins are then turned over to the pumicer, who, after

placing them upon the beam, proceeds to rub the places from which the grain has been removed with pumice-stone.

Skins which are to remain white for a time, and to be colored afterwards, are treated by applying very fine sea-sand, and rubbing quickly and forcibly up and down, or backward and forward, with the pumice-stone held in the right hand, while the left hand grasps one end of the skin.

For leather, which is to be of a pale-yellow color, a stone is prepared by pulverizing 6 parts of *Mendon* white (a variety of chalk) and 2 parts of yellow ochre. The ingredients are mixed, and, after moistening and kneading, the paste is moulded, and the resulting stone used for rubbing the places from which the grain has been removed. The workman presses the pumice-stone strongly upon the surface of the skin, and rubs as quickly as possible, adding occasionally some fine sand, and continuing the rubbing as long as for skins which are to remain white or are to be colored afterwards.

By thorough pumicing the fineness of the skin imparted by the above treatment, and removal of the grain is augmented. It is rendered still finer and smoother by smoothing with a flat-iron after stretching, and can then be used for the best quality of gloves.

Danish Glove Leather.

In order to prepare supple *Danish* glove leather the method of finishing *glacé* leather can be combined with the process of preparing tanned leather. By treating the skins with weak tan-liquors the desired color is obtained, though a complete tanning is not effected. The skins are then scraped upon the flesh side, and treated with a tawing paste composed, for 144 goat-skins, of 4½ pounds of alum, 2¼ pounds of common salt, 13¼ pounds of fine rye flour, and the yelks of 300 eggs, to which is added some birch-tar oil to imitate the weak odor of Russia leather, characteristic of Swedish or Danish leather. The skins are worked with the paste in the same manner as already described, and, after drying, placed in a damp cellar for some time, and finally rubbed upon the grain side with a woollen rag dipped in

amianthus or tuffaceous limestone. If such Danish leather is to be used for gloves it is absolutely necessary to have the flesh side, which is worn outside, as smooth and uniform as possible. To effect this the skins, after scraping upon the beam, are rubbed in the above-described manner with pumice-stone, to which it is advantageous to add some fine sea-sand. After rubbing the surface as smooth as possible, the skins are finished by treating with a polishing roller or flat iron.

Jennings's Method of Tawing.

Jennings, in 1861, obtained a patent in England for a special method of preparing white leather, which differs not only from the ordinary method as regards the nature of the tawing substances used, but also as to the quality of the leather produced. The preparatory labors, such as soaking, rinsing, liming, and depilating, and working upon the beam, are precisely the same as in the ordinary method, though we will remark here that depilating is best effected by previous liming. If it is to be accomplished by the sweating process, it will be necessary to treat the skins afterwards with weak lime-water. To accomplish a loosening of the tissue and saponification of the fat, an after-liming for 24 hours will, on an average, be necessary. The process is available for all kinds of skins, though it is especially adapted for heavy ones.

After liming and washing the skins are worked upon the beam to assist the removal of the lime soaps, and then placed in an acid bath composed of a mixture of 98 parts of pure water and 2 parts of concentrated hydrochloric acid where they remain, with frequent careful stirring, until the removal of the lime and raising of the tissue produced at the same time by the action of the acid, are as completely effected as possible, two or three hours being as a general rule required for the purpose. The skins are then taken from the bath, and, after draining off, subjected immediately to the tawing process. This is effected by placing the skins in two different tawing fluids prepared in two separate pits or vats. One fluid consists of a cold saturated solution of alum in water with an addition of about 2 per cent.

of sulphuric acid, and the other of a cold saturated solution of crystallized soda with an addition of about 5 per cent. of dry sodium tungstate. The preparation of these fluids is readily accomplished.

For the first pour cold water, not sufficient to dissolve it, over a large quantity of crystallized alum in a vat, and allow it to stand with frequent stirring until the quantity of alum not dissolved no longer perceptibly decreases. Then run the obtained solution into the tawing pit or vat, and add, with thorough stirring, the corresponding quantity of acid.

The other fluid is prepared in the same manner, and the corresponding quantity of sodium tungstate previously dissolved in the necessary quantity of water is added.[1]

After filling the pits at least half full with the respective fluids, the skins are first placed in the one containing the alum solution. To facilitate the immersion of the skins and their removal from the pit Jennings makes use of a very convenient method. He employs for the purpose a perforated wooden frame large enough to spread upon it a large skin. Upon this frame he spreads out a skin, places upon this a hurdle of pealed osiers, upon this a skin, and so on until 10 to 12 skins are placed upon each other separated by hurdles. A hurdle is placed on top and fastened to the frame with cords so that the whole forms a bundle. By means of handles the bundle is then immersed in the pit so that it is entirely covered by the fluid.

After remaining in the alum solution for six hours, during which time the fluid washing around the skins is renewed 2 or 3 times by repeated lifting and replacing the bundle, the skins are taken out, and, after draining off over the pit, placed in the one containing the soda solution, where they remain for 5 hours, and, after draining off, are replaced in the first pit. This alternate moving from one pit into the other is repeated until the skins are converted into leather, which is recognized by the opaqueness of the cut surface and the fibrous structure. The time

[1] In case determined proportions by weight are preferred it is necessary to use for the alum solution 100 parts of water and 9½ parts of crystallized alum, and for the soda solution 100 parts of water and 16½ parts of crystallized soda.

required for the operation depends of course on the size and thickness of the skins, but can be hastened somewhat by using the solutions lukewarm, say at about 96° to 100° F., which is recommended and necessary in winter. To increase the producing capacity it is of course advantageous to work with at least two frames, so that, while one bundle is in the one solution, the other is treated in the second.

After the skins are taken from the tawing fluids they are first placed in a bath of sodium tungstate and finally in one of soap. The first is prepared by dissolving the sodium tungstate in a sufficient quantity of water, allowing the solution to settle and pouring off the supernatant clear fluid from the sediment. The skins remain in this solution, with frequent stirring, until they are completely saturated, the process requiring as a rule several hours. They are then taken out, and, after draining off, placed in the soap bath prepared by dissolving 15 to 20 parts of ordinary white soap in 100 parts of water. The skins remain in this solution until they have absorbed almost all the soap, which is recognized by the fluid feeling no longer slippery, and ceasing to foam. The process can be considerably hastened by frequently working the skins in the bath. The final operation is rinsing the skins to free them from an excess of salts. As simple rinsing is not sufficient for this purpose, the skins are soaked for 24 hours in water frequently changed, and after a final rinsing in clean water, dried, and submitted to the finishing process. The color of leather thus prepared being not entirely white, it is more advantageous to use it for preparing colored varieties. If it is to be brought into commerce as natural leather, it is best to give it the appearance of tanned leather by placing it before drying in weak tan-liquor for 15 to 24 hours, according to the thickness of the skins. After the leather is thoroughly permeated with the liquor, which can be more readily effected by the use of pressure, it is dried and finished. Where a higher degree of softness and suppleness is desired, the finished leather can of course be greased, the process being the same as the one described for the Hungarian method of tawing. For obtaining fine and very white leather by Jennings's method, the use of the above tawing fluids alone is not sufficient. To

give the tawed leather a proper degree of whiteness. Jennings recommends dissolving 5 per cent. of zinc filings in the acidulated alum solution, for which might perhaps be substituted a correspondingly larger quantity of oxide of zinc or sulphate of zinc.

As regards the theory of this method of tawing we may make the following general remarks: It is, of course, self-evident that the action of the alum upon the fibres of the skin tissue does not materially differ from any other method where alum is used for tawing. But what is the object of the succeeding treatment with soda solution? To understand this thoroughly we must consider the behavior of alum towards soda. Alum, *i. e.*, aluminium sulphate on meeting soda, *i. e.*, sodium sulphate, is decomposed and soluble sodium and potassium sulphates are formed on the one hand, and on the other insoluble aluminium hydrate. There can be no doubt that by the action of the soda solution upon the skin the fibres of which have absorbed a certain quantity of alum by the treatment in the alum bath, the same process of decomposition is introduced, and that the particles of alum present in the tissue are, on the one hand, converted into sodium and potassium sulphates, which being easily soluble are absorbed by the surrounding liquid, and, on the other hand, into aluminium hydrate which, being insoluble, will remain in the place formerly occupied by the particles of alum. In this manner the tissue of the skin will, by the repeated alternate immersion in the alum and soda baths, be gradually saturated with aluminium hydrate until finally not only the separate fibres will be coated with the aluminium combination, but the interspaces will also be filled with it. The sodium tungstate, which under certain conditions can effect a sort of tawing, though not a complete one, might, as far as the matter can be judged from a theoretical standpoint, play only a subordinate role, and is very likely added to assist the tawing and perhaps make it more constant. A skin the tissues of which are filled with aluminium hydrate is no doubt genuine leather, but it lacks properties demanded of good leather, which must principally possess a certain degree of softness and suppleness. Dry aluminium hydrate being earthy and rough, its presence must oppose

a considerable resistance by friction to every motion of the tissue fibres. To obviate this evil, and to decrease as much as possible the friction of the separate parts, the skins are treated in the soap bath, by the action of which upon the aluminium hydrate an alumina soap is formed, which consists of a slippery mass offering but little resistance to the shifting and moving of the tissue fibres enveloped by it. The treatment in the soap bath could thus only be omitted at the expense of softness and suppleness, and its continuation is therefore advisable.

The object of adding zinc filings, or a soluble zinc salt, to obtain a higher degree of whiteness, is easily explained by the circumstance that by the action of soda solution upon soluble zinc salt, carbonate of zinc, *i. e.*, a body of a pure white and great power of covering is formed, which, when deposited in the tissue alongside of the aluminium hydrate, imparts to it its whiteness. It is, therefore, of no consequence whether zinc shavings are added to the acidulated alum solution or a soluble zinc salt, for instance, sulphate of zinc; in fact the latter is preferable, as in case sufficient time had not been allowed for the zinc shavings to dissolve the skins coming from the soda solution containing tungstic acid might assume a blue coloring, which, though only transient, would disturb the regular course of the work. We would finally remark that the tawing effected by Jennings's method is more constant than that by the ordinary process, and the leather resists the action of water much better. The cause of this phenomenon must be found in the fact that by Jennings's method the fibres are enveloped by an aluminium combination almost insoluble in water, while in the ordinary method the tawing is effected by the absorption of a more or less soluble combination.

Defects of Alumed Varieties of Leather.

The defects are either natural ones, or originate from storing or the manner of working.

Perforated skins are frequently found, the holes in most cases being made by the maggot of the large blue fly found so frequently in butcher shops, feeding upon the particles of fat and

flesh adhering to the stripped skin. The fly frequently deposits its eggs in the folds of the still moist skin, and the maggots on making their appearance and finding no other food attack the leather itself. The skins should therefore be stretched and dried immediately after stripping them from the animals.

Lambs, and sheep still more so, are subject to diseases leaving their effects upon the skins, as for instance the small hard places, about the size of a pea, occurring principally on the back and neck, which must be classed among the worse defects, as they do not take the color. These lumps originate no doubt from chicken-pox, which frequently attacks entire flocks.

Another similar disease produces smaller spots, and frequently only depressions, so that the skins can be at least used upon the flesh side. Such places are frequently found in goat-skins brought from hot countries.

Another injury to the skin, chiefly found on the sides and upon the grain side, originates from not keeping the animals clean. By the dung, moistened by the urine, adhering too long to the animal, not only is the wool injured but the skin also. Such skins can only be used for dark colors and frequently only for black.

Marks of varying shapes and of a wine-lees color, which do not disappear in tawing, are called *blood stains*. They are very likely a kind of liver spot or mole. Actual blood stains are also found on the edges of large sheep-skins. They are caused by the blood adhering to the skins decomposing and producing indelible stains.

The wool, or the hair of the skins of goats and lambs, is either white or reddish, or black, and sometimes spotted. The white skins, which are the most frequent, have after tawing a dull white color, while the black ones are more beautiful, but have a bluish-white color. Spotted skins are also more or less irregularly spotted so that they can never be used for white gloves, and frequently not for even light colored ones.

Skins, the grain of which is only slightly connected with the grain side, and the tissue of which is loose and hollow and can be easily torn, are called swelled or distended. Such skins are only obtained from diseased lambs or sheep, or from flocks fed upon

fat pastures. They are only used where more regard is paid to cheapness than to good quality. In reliable factories they are not worked, at least not upon the grain side.

Skins of animals which have died of a kind of wasting disease, are called dry skins. They are generally thin, without elasticity, have large open pores, and cannot be improved even by the most careful working. They are unfit for gloves.

It is frequently found that the grain side becomes partly detached from the skin. This is caused by the skins becoming heated while stored. This evil can be prevented by stretching and thorough drying of the skins before storing them away.

Skins attacked by certain kinds of moths show, after tawing, the course the moth has taken in gnawing off the wool, while the small larvæ of the genuine moth do not penetrate to the skin. The marks left upon the skin are not produced, as is erroneously supposed, by the bite of the insect, but by an acrid fluid running from the mouth of the insect while cutting the wool, and which very likely promotes the separation of the wool from the skin. Skins furrowed in the above manner were formerly frequently found in workshops where the wool was removed by means of a sharp slate, but scarcely ever occur since the general introduction of the scraping-knife for depilating.

We have already spoken of the injury to which the skins are liable in branning in case the fermentation is too strong.

It is frequently the case that small fissures or similar injuries are found upon the grain side, which are partly caused by the butcher inflating the skins and partly by the workmen, while tawing the skins, especially in depilating and scraping. The skins of young animals fed upon moist pastures, as for instance the goats in the vicinity of Paris, require the most careful treatment in tawing as well as in coloring, to prevent them from receiving such injuries during the course of the work.

The best skins will sometimes turn out hard if not thoroughly worked by the tawer, and especially if too little tawing paste has been applied. By treating such skins before tawing in the manner mentioned later on, they will be rendered sufficiently soft.

Gases being developed in consequence of a fermenting process taking place in branning, it occurs occasionally that the gases developed by the fluid absorbed by the skins, cannot find a suitable way of escape and are collected between the epidermis and the true leather skin. By an increase of gas the respective portion of the skin is distended and a detaching of the epidermis from the other skin tissue is the result. Such skins have the appearance in a moist state of being covered with blisters. Though these blisters disappear in drying, the skins never acquire a perfectly smooth surface or, in short, a clean grain.

The best way of preventing this evil is not to use the bran steep too strong, and avoid excessive fermentation by keeping up a moderate temperature, and also by frequent handling of the skins while in the bran steep. In case the detached skin is perfectly clean and free from other parts of the skin it is in much demand by manufacturers of artificial flowers, who use it especially for imitating orange blossom.

The ordinary reddish bran stains are caused by the use of bad or impure bran. In dyeing such skins, the stained places form small grayish spots. These spots, which are also called rust stains, may be formed by filings dropping upon the skins in sharpening the stretching iron. To avoid them the workmen should never be allowed to sharpen their tools in the vicinity where skins are piled up. The appearance of similar grayish spots after coloring the skins is due to another cause. Portions of the tissue of skins stored in a damp place undergo decomposition, the formation of mould on the surface of such places being observed at the same time. The appearance of the spots is caused by the products of this process of decomposition. The spots are readily detected by holding the skin, before cleansing it for dyeing, against the light. The skin has suffered injury when blackish stains are observed in the interior. Such skins can only be utilized for very dark leather.

A very frequently occurring defect is technically called shading. It is very plainly noticed especially in colored leather. One cause of this defect is that not sufficient care has been used in hanging up the skins to dry. By throwing the leather over the

pole more tawing paste collects generally on those places resting immediately upon the pole, and the whole width of the leather shows a streak corresponding to the greater collection of tawing paste, which indicates a somewhat differently constituted substance from the remainder. This difference is not noticed in white leather, but in dyeing it will appear plainly, as such places will show a more intense coloring than the rest of the skin. This defect is also frequently caused by stretching the skins taken from the tawing paste, and can scarcely be avoided where the stretching is executed by drawing the leather back and forward over a wooden pole. By the pressure exerted upon the leather in pressing it against the wooden pole, a kind of streak or several streaks are produced if the work is not done uniformly, which after dyeing show a darker coloring. This evil can be avoided, on the one hand, by not drying them upon poles, but suspending them, as previously mentioned, their entire length, and, on the other hand, by stretching them only with the hands without the use of a wooden pole, or, if the latter has to be employed, by being careful to stretch the leather uniformly and drawing it over the pole not only crosswise, but also lengthwise and repeatedly in different directions. Another cause of shading is subjecting the skins to too strong a lime-bath, or it may be produced by the grain of the skins in the lime-vat being partly injured or entirely destroyed by the action of the air, in consequence of which the finished leather will be without lustre and dull.

The defect of what is called rotten or burned leather was formerly attributed to various causes, none of which is however correct. Credit is due to Prof. Knapp for having thrown light on this subject by a series of interesting experiments. Without entering into details, we will only give the conclusions Knapp has arrived at as to the cause of the rotteness of leather. There is no actual burning, as the fibre of the tissue is not injured or destroyed but remains entirely intact. The cause of the defect is due to the presence of certain salts enveloping the fibres and by forming a brittle coating depriving them of the power of resisting a tearing force. Knapp compares the condition of such fibres with that of the threads forming the wick of a stearine

candle which, though in a normal state, are broken in breaking the candle, the presence of a brittle substance enveloping them weakening their power of resistance. The cause of the rottenness of the leather must, according to this, be due to the fibres becoming, in the course of the tawing process, enveloped with a more or less brittle substance or at least a hard one, and the evil could be entirely avoided by removing such coating or preventing its formation. And this is actually the case. Knapp proves unequivocally that the formation of such brittle substances is due to a remnant of lime either by itself or in combination with the fibres, which by the succeeding action of the alum liquor is converted into calcium sulphate, the latter being deposited in the form of brittle crystalline masses upon the surface of the fibres. The most suitable means of prevention would therefore be to use the greatest care in removing the lime from the skins, which can be best effected by thorough and repeated stretching of the depilated skins and by subsequent use of the acid bran steep, and, still better, by hydrochloric acid baths. Skins containing too much lime are improved by treating them with a dilute solution of sodium phosphate, or, as Knapp recommends, with a soap solution. These agents do not remove the lime from the tissue, but produce the desired effect by forming combinations with the lime not inclined to form such crystalline envelopes upon the fibres. A similar effect, although only within certain limits, is produced by the use of a bate of dog excrements, and also by such substances as flour and yelk of egg employed in the French mode of tawing, this being the reason why rotten leather will result more seldom by this process than in the ordinary method. Oiled leather also shows this defect very seldom, in fact, apparently rotten leather can frequently be restored by oiling, as the fat penetrating the tissue forces its way also between the crystals of the calcium sulphate enveloping the fibres, restoring, at least partly, their flexibility.

We would finally draw the attention of our readers to a defect occasionally observed in colored leather and consisting of white spots which will take no color whatever. The occurrence of these spots has thus far not been satisfactorily explained nor a

means found to prevent them, and it is simply a supposition to say that their production might be due to small pieces of egg shell which adhere to the skins in treading them in the tawing paste.

Manufacture of Oil or Chamois Leather.

Oil or chamois leather has various employments, and undergoes a treatment which imparts to it a softness, suppleness, and woolly nature resembling that of woollen goods, and the property not possessed by any other variety of leather, of standing washing without losing any of its good qualities. For this reason, it is also frequently called *wash leather*.

As, on account of its denser tissue, the upper layer of the corïum does not possess the same stretching capacity as the lower, the grain is generally entirely removed, especially in thick skins, so as to give both sides the same appearance. For making leather capable of standing washing, it is necessary that the fibre should not lose its tawing when placed in water, nor shrink to a horny mass in drying. The fibre acquires this property by treating the properly prepared skins with oils and fat. The tawing is, however, not effected by the pure unaltered fat, but is partly due to other factors the importance of which must not be underrated. Among the principal of these, we must class the action of heat and air, and especially the oxygen of the latter by the action of which the fats absorbed by the skin tissue undergo an alteration the products of which must be considered as the actual tawing agents.

The products formed by the chemical alteration of the fat not only unite the fibres so far as to give them all the characteristics of being thoroughly tawed, but prevent the fat contained in the leather from being detected by any external marks. But although the percentage of fat deprives more than any other means the fibres of the capacity of shrinking and sticking together, it would be erroneous to suppose that it prevents water from penetrating the leather.

This branch of the trade takes its name from the skins of the chamois, but, although the term is still retained, those of sheep,

deer, lambs, and goats, and even ox-hides and calf-skins, are now converted into it. The product obtained from the latter is almost exclusively used for military equipments, such as belts, etc., while the leather produced from the first is worked into pantaloons, bags, bandages, gloves, etc., though we would here remark that of late the use of chamois leather for these purposes has considerably decreased.

The manufacture of chamois leather has undergone but little change in the course of time, nearly the same process being in use at present as in the last century. The operations may be divided under the following principal heads: 1. Soaking and rinsing. 2. Liming, depilating, and frizzing (removing the grain). 3. First liming of the frizzed skins. 4. Stretching and scraping. 5. Second liming of the frizzed skins. 6. Branning. 7. Squeezing or pressing. 8. Fulling in the oil. 9. Dressing and finishing.

Soaking and rinsing and liming to prepare the skins for depilating being the same as used for ordinary alumed leather, require no further description.

After thorough liming the skins are ready for

Depilation and Frizzing.

These operations differ materially from the method employed for alumed leather. The grain of the skin being, as previously mentioned, the densest part, is not adapted for such a high degree of softness and suppleness as is demanded in chamois leather, and besides prevents, on account of its density, a ready penetration of the fat. For the production of good wash leather it becomes therefore necessary to remove the grain, though it is done at the expense of lustre and smoothness. In depilating skins intended for chamois leather, it is therefore not necessary to be careful of the grain except with very weak skins of young animals, the solidity of which would be injured by the removal of the grain, and in case the wool is to be utilized for other purposes, as wool removed simultaneously with the grain has no value. In all other cases the depilation and frizzing are accomplished at one operation, *i. e.*, the hair or wool and the portion of the skin in which they are imbedded are removed together, the

workman using for the purpose a sharp scraping-knife similar to the one employed for skins intended for alumed leather. The treatment with the scraping-knife being generally not sufficient for complete frizzing, the remaining portions of the grain are removed with another sharp knife. After frizzing and rinsing, or without the latter, the skins are subjected to the

First Liming.

For this purpose they are placed in an ordinary lime-vat and subjected to the action of lime-water for 12 to 48 hours according to their size and thickness. The object of this treatment, which is equivalent to the raising of skins intended for alumed leather, is besides the saponification of the fat constituents of the skin, to loosen the skin tissue for the succeeding treatment. The next operation is

Stretching and Scraping upon the Flesh Side and partly upon the Grain Side.

This is accomplished upon the beam with a scraping-knife, the object being to free the flesh side from adhering particles of flesh and fat, and the substance of the tissue from the lye and lime-soaps which have been formed, thus preparing the skin tissue for the absorption of fresh lime-water in the

Second Liming.

This is generally accomplished by placing the skins for 24 to 48 hours in a vat charged with fresh lime-water prepared in the ordinary manner for raising skins. By this treatment the skins acquire the necessary degree of softness and sponginess required for the succeeding operations.

After removal from the lime-vat, the skins are thoroughly rinsed in lukewarm water in order to free them from the greater portion of the adhering lime, and are then subjected to

Branning.

For this purpose the skins are placed in a bran steep acidulated by standing several days, for the preparation of which the same proportions in quantities are used as given for alumed

skins. The acid steep should be warmed before pouring it over the skins in the vat. After a partial permeation of the skins, which is generally effected in a few hours, during which time they should be kept immersed by proper weights, a complete saturation is accomplished by treading them in a vat, in order to make the action of the steep uniform upon all parts of the skin tissue, and to accomplish a complete removal of lime from the fibres, which is the principal object of the sour steep. In place of treading, the object may be effected by pounding the skins in a low wooden vat or special fulling trough with a round wooden mallet. The pounding is continued, with an occasional addition of bran steep, until the skins have acquired a uniform milk-white appearance, and show, when held against the light, no dark spots, this being generally accomplished in winter in 2 days, and in summer in 12 hours. The skins are then squeezed or pressed in order to remove as much water as possible, this operation requiring no further description, as it does not differ from the ordinary method pursued in tawing. We will only mention that it is advantageous to use a wooden instrument in place of the usual iron one, especially for leather to be colored afterwards, in order to avoid spotting, frequently brought about by the skins taken from the bran steep coming in contact with iron instruments. After thorough wringing and swinging in the air the skins are again fulled and while still moist immediately oiled.

Fulling in the Oil.

Fish oil, obtained from seals, whales, sturgeons, dolphins, and herring, is preferred for this purpose, partly on account of being cheaper and partly because other fats do not give as good a product. The only oil worth mentioning besides the above is olive oil, while linseed oil, rape-seed oil, and poppy-seed oil must be designated as absolutely worthless, as they furnish a poor product even when used as an addition to fish oil. Oil of juniper deserves, according to Schmidt, consideration as the volatile oils free from oxygen dissolve the fat of the connective tissue and are oxidized much more quickly than fish oil and converted into soft resins, which form with the fats and the alkalies, a more solid

resin soap enveloping the connective tissue fibres, than is the case with fish oil. But the introduction of this material has found but a limited use as might be expected from the material difference existing between this and other oils. The operation of tawing consists in spreading about 12 dozen skins, or as many as are required to fill the trough of the fulling mill, grain side up, upon a table, and after sprinkling upon them oil, distributing it uniformly over the surface with the palm of the hand. The skins are then rolled up in bundles of four, and subjected to the action of the fulling mill. This latter for this class of leather manufacture is generally driven by horse-power, and is the same as an ordinary cloth fulling mill. It has two hammers and two troughs capable of holding a gross of skins or more. The hammers give 15 or 16 blows per minute.

The first fulling is continued for a period varying from 2 to 3 hours, the time depending partly on the temperature of the air and the more or less porous condition of the skins. They are then taken out, and after swinging in the air in order to unfold them, suspended to cords in the open air to cool off from the heating consequent on fulling, and to allow of a better penetration of the oil by a partial evaporation of moisture. After half an hour to an hour the skins, after rolling them again into bundles, are fulled without oil for 1 or 2 hours, suspended in the air, oiled, again fulled, suspended in the air, fulled without oil, and so on, the process being repeated until the skins have been hung 6 to 8 times in the air, being fulled each time and receiving oil 3 to 4 times or oftener for poor skins.

Fulling is the most important and at the same time delicate operation in oil-tawing, the smoothness and softness of chamois leather, so much admired, being entirely due to it. Formerly a fulling stock descending perpendicularly upon the skins was used, but more recent constructions are provided with a kind of hammer, the arrangement of which will be more plainly seen from the illustrations in Chapter XIV.

The skins will be sufficiently oiled when a smell of mustard takes the place of that of flesh. The skins should gradually lose their water by repeated suspensions in the air, since the oil penetrates more easily in the degree in which the water evaporates,

and thoroughly dry skin absorbs the oil with great difficulty and requires more frequently repeated fulling. The skins remain generally suspended until the surface appears dry. It is best to hang them in the open air or in case the weather is unfavorable in an airy loft. Towards the end of the operation, when the skins have lost the greater portion of water, they are suspended, in damp weather, in a heated room. Chamois skins are given 12 fullings, other skins proportionably less. A dozen buck-skins absorb about 18 ounces of oil at each oiling, a total of about 9 to 10 pounds of oil being required for a dozen sheep-skins, and about 13 to 13½ pounds for a dozen buck-skins. Thus far the object of the operations is principally to thoroughly and uniformly impregnate the skins with oil, repeated fulling playing a principal part. By the repeated exposure to the air a part of the oil has, however, already undergone a partial alteration by the action of the oxygen of the air causing the formation of various products of oxidation, which chiefly impart to the skin the property of leather. But the principal portion of the fat is still present in an unaltered state, and fills only mechanically the interspaces of the tissue. The object of the succeeding operations is to convert the unaltered fat so as to adapt it to form an intimate combination with the skin tissue, and to bring about a lasting tawing of the skin. This is effected by the oxidizing action of the air, best produced by the co-operation of a gentle heating; therefore, by the introduction of what has been erroneously called "a fermentation accompanied by heat."

After the last fulling and thorough swinging in the air, the skins are piled in a cone-shaped heap upon the floor of a heated chamber previously covered with a linen cloth, and allowed to rest some time. In some workshops the pile is also covered with a linen cloth, though this is not absolutely necessary. In cold weather the skins must be heated before piling them up, which is effected by suspending them on poles arranged near the ceiling of the heating chamber. The interior of the pile soon becomes perceptibly heated by the oxidation of the fat permeating the skin tissue, which is caused by the admission of

air, the color of the skins changing gradually into yellow as the process of oxidation progresses.

To obtain a good product the heating of the skins must be carefully watched and special precaution taken to avoid over-heating of the pile, as otherwise a more or less brittle leather would be the result. The temperature of the pile should therefore be examined from time to time by introducing the hand. If a considerable heat is felt, the pile, in order to avoid a failure of the process, is rapidly torn apart, and a new pile formed as quickly as possible to prevent too rapid cooling, by placing the skins previously in the interior, on the outside of the pile. After allowing the pile to rest for some time, it is again changed in a similar manner. This reforming of the pile and subsequent resting is repeated until the skins have acquired the right shade of color, which, as previously mentioned, takes place in consequence of the oxidation of the fat. When the latter process is finished, the skins will no longer become heated to any extent, so that the gradual decrease of heat may be considered as a sign of the process being finished. After passing through the process in the heating chamber the skins, in order to furnish available oil leather, must still be subjected to

Finishing and Dressing.

The principal object of these operations, besides the other mechanical treatment, is the removal of the excess of fat contained in the tissue. For this purpose the skins are first worked with the stretcher and then upon the grain side with a somewhat dull round knife to remove any grain still remaining. This operation is especially required for skins of chamois, deer, and goats, whose upper skin is rather thick, and if any of the grain remained it would form, after drying, a stiff and hard surface impairing the fine, woolly appearance of the grain side, which is worn outside in articles manufactured from the leather.

Although the greater portion of the oil combines in an altered state with the skin fibre, the skins contain a considerable quantity of uncombined oil, which is removed by means of an alkaline lye, prepared by dissolving, for 1 dozen sheep-skins, about

$1\frac{1}{8}$ pound of potash in warm water, less being required for skins previously scraped. The skins are immersed in the bath and when thoroughly soaked taken out and wrung, the immersion and wringing being repeated three or four times until the leather is thoroughly cleansed.

As a considerable amount of potash, which is comparatively dear, and frequently contaminated, is used in the manufacture of chamois leather, Hermbstaedt proposed, some years since, the use of soda as a substitute. This would be still more advantageous at the present time, since soda is now produced in immense quantities and of great purity, and is not only as effective as potash, as already proven by Hermbstaedt, but even superior to it. The proportions, for 1 dozen skins, are about $1\frac{1}{8}$ pound of calcined soda, or $3\frac{3}{8}$ pounds of the crystallized article for the same number of skins.

The use of a caustic lye has proved still more advantageous than either potash or soda, and experience has shown that only half the soda in the form of caustic lye is required as of potash. Caustic soda lye is obtained without difficulty by preparing first a clear solution of soda in lukewarm water and adding a paste of fresh slacked lime made by converting, for every $2\frac{1}{4}$ pounds of soda to be used, $1\frac{1}{8}$ pound of lime into a fine powder by pouring as much water over it as it will absorb. The powder is stirred into a thick paste with sufficient water, and added with vigorous stirring to the previously prepared soda solution. After standing for several days during which the fluid is frequently stirred, the caustic lye is ready. For use the supernatant clear fluid is drawn off.

By scraping and treating with lye the skins lose about one half of the oil originally absorbed. The liquor running off in wringing out the skins treated with lye, which is a solution of a soap-like body partly clouded by the mechanical admixture of fatty substances, is the so-called *dégras*, an article of considerable value, which should be carefully collected.

The value of this liquor will be made plain by considering that it contains the greater part of the excess of oil from the skins and a small part of the products of the oil formed by the process of oxidation. This product can in fact be used for

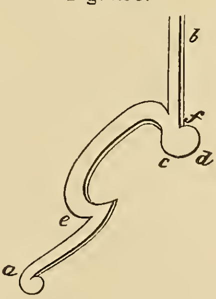
moistening oil leather to be bleached and, after evaporating the water, for oiling other varieties of leather, especially tan-leather.

The liquor can also be used in place of fish oil by neutralizing the alkali contained in the soap-like combination in solution, by means of hydrochloric or sulphuric acid, and skimming off the oil separating on the surface of the fluid. This is effected by diluting the soap-like mass pressed from the skins by fulling with a quantity of water and adding with vigorous stirring small portions of sulphuric acid until the fluid has acquired an acidulous taste. By subsequent heating the fatty substance collects upon the surface.

As strong heating takes place on mixing sulphuric acid with water, it is advisable to mix the acid drop by drop with 4 to 6 parts of soft water and add the diluted acid to the liquor. The simplest way is to use hydrochloric acid. In treating the liquor in the above manner with hydrochloric acid the latter combines with the soda or potash into the soap-like substance, and separates the pure fat which floats on the surface. The separation is promoted by heating the fluid.

After freeing the skins from the excess of fat they are wrung and dried in the air, if the weather permits, or in the drying chamber. When dry the skins are worked with the stretcher in order to restore to them the proper suppleness partly lost in drying. Small skins are worked in the usual manner.

Fig. 298.



For strong leather a stretching iron represented by Fig. 298 is used. It is fastened to the wall of the workshop. The leather is scraped lengthwise upon the blunt round edge *c d*, and in width upon the dull curved edge *e f*, the latter being specially used for the thick places in order to make them supple. After this operation the skins are finished with the hone to give the surface the required uniformity, buck-skin undergoing this process on both sides, but sheep-skins on the flesh side only.

The leather is finally finished by passing a smoothing iron over the honed side in the same manner as in alumed leather.

Chamois leather is generally of a buff color. To bleach it the skins are placed upon the bleaching ground in the sun and sprinkled with water, and when dry again sprinkled. When half white they are soaked in dégras and replaced in the sun. In place of dégras, soap water prepared from white soap can also be used.

In bleaching the leather from chamois skins intended for gloves and that from skins of sheep, goats, and lambs for castor gloves, is at the same time pumiced. For this purpose the skins are trodden for one hour in a weak solution of potash composed for 12 dozen skins, of $2\frac{1}{4}$ pounds of potash in 79 pounds of water of 88° F. They are then wrung out, and after swinging in the air, placed upon the bleaching ground for 48 hours. The dry skins are then pumiced with white pumice-stone in the same manner as given for alumed leather, some fine sand scattered between the skin and the stone facilitating the work as the sand detaches the fine fibres. After pumicing and smoothing and moistening the skins with dégras they are spread upon the bleaching ground to bleach entirely. When dry they are alternately sprinkled with pure water and dégras, the latter restoring to them their original softness. For leather intended for white gloves, the sprinkling is repeated 8 to 10 times, while 3 to 4 times are sufficient for leather to be worked into yellow or colored gloves.

The required shade for buff-colored leather intended for pantaloons, gloves, etc., is prepared by mixing with water to a thin paste the requisite proportions of yellow ochre, whiting, and some Dutch or English pink, adding a little starch paste to prevent the color from dusting when dry. Apply the color with a stiff brush, stretch the skin when dry and finally remove the loose dust by vigorous shaking.

To clean dirty leather proceed in a similar manner. After washing with a brush and soap-water mix the above buff color with sufficient olive oil to a ball, dilute this with the requisite quantity of water and apply with a stiff brush to the moist

leather. When dry rub with a dry brush. For white leather use fine whiting in place of the buff color.

A variety of oil leather which has been colored black on the flesh side, and the grain of which has not been scraped off, is prepared for shoemakers' purposes. It is manufactured from calf-skins scraped smooth upon the flesh side and blacked in the manner given later on.

The so-called *twisted leather*, which is much used in some countries for straps, may also be called a variety of oil leather. It is said to excel in durability and suppleness. For manufacturing it, depilate cowhides, which are generally used, by scalding with boiling water, and, after softening sufficiently, cut them into strips. Sew the strips into one long piece, and then sew the two ends of this together. After saturating with oil hang one end of the material on a hook and suspend a weight to the other. Then insert a stick between the two strips and after twisting them together, allow them to untwist in the opposite direction, repeating the operation several times and applying fat. By this operation the leather becomes heated and gradually saturated with fat. This method, as can be readily seen, will only serve as a partial substitute for fulling in oil.

Preller's Method of Tawing.

Preller, on the 8th of March, 1852, obtained a patent in England for a peculiar method of preparing leather, but the merit of the invention is claimed by Theodor Klemm, of Pfullingen, who states that Preller bought the patent from him. Herewith we give a description of the process as patented by Klemm in Germany in 1849, which is substantially the same as the process patented by him in the United States in 1858. According to the specification, the process consists in impregnating the skins or hides with a mixture composed of certain animal, vegetable, and salty substances. The animal substances used are bullocks' brains, butter, milk, and animal fats; of vegetable substances those are preferred which contain most starch and but little gluten, for instance, barley flour, rice flour, or starch by itself. The salts used are common salt and saltpetre. The fol-

lowing mixture gives good results: Barley flour 26 parts, bullock's brain 23, common salt or saltpetre 4, unsalted butter $6\frac{1}{2}$, milk $12\frac{1}{2}$, animal fat, such as neat's-foot oil or horse fat, 28. After mixing the butter and bullock's brain, add the flour gradually, then the fat, and finally the milk. The salt, the object of which is to preserve the butter and brain, can be added in the beginning.

After depilating, soaking, and partly drying the skins or hides to be treated, place them in a cylinder and set the latter revolving. The skins remain in the cylinder until by the motion imparted to them, the water still contained in them is uniformly distributed. The above mixture is then applied to the flesh side, and after replacing the skins in the cylinder, the latter is set in motion. The application of the mixture and revolving in the cylinder are repeated until the desired success has been attained, thick skins requiring of course a longer time than thin ones. The skins while revolving in the cylinder may also be heated by the introduction of warm air. In place of a revolving cylinder other means may be employed to impart to the skins the requisite motion. The succeeding operations to which the skins are submitted are the same as in the ordinary process, though the finishing is considerably facilitated by the foregoing treatment.

The owner of the patent erected a factory in Southwark (London), in which the above process is used. The establishment has been considerably extended since the products are said to be much in demand. The mixture used is the one stated in the specification of the patent. The skins are spread out upon a table to receive the tawing mixture upon the flesh side. They are then placed in revolving stuffing-wheels, 8 to 9 feet in diameter and 5 feet deep. The skins are placed in the interior of the stuffing-wheels and removed through openings in the sides. The interior surfaces are provided with strong pegs, radiating from the centre, the object of which is to beat the skins vigorously to promote an equal distribution of the water contained in them, and a uniform absorption of the paste. The drums are driven by steam power, and can be made to revolve

quicker or slower according as the course of the operation requires it.

To effect a drying, which is frequently required, the exhaust steam is conducted into a large receiver from which runs a pipe along the floor of the room. The pipe is connected with the interior of the stuffing-wheels by means of pipes and hollow shafts, the connections being opened or shut by means of cocks. The skins, after being revolved for a few hours (the time depending on their thickness), are taken out and examined, to ascertain whether the absorption and partial drying has been thorough and uniform. Skins not thoroughly saturated are, after hanging in an airy place for a short time, treated with a new application of the paste, and after replacing in the cylinder treated as before. The entire operation is repeated once more, after which cuts made in the skins should show by their uniformity of color that the conversion into leather is complete. The skins, after a slight drying, are ready for finishing.

Leather prepared according to Preller's process is called *H B Crown*, and has proportionally less weight and thickness than tan leather. Experiments have shown that while 220 pounds of green hide tanned with bark give 110 pounds of leather, the same weight tanned by *Preller's process* yields only 81½ pounds. The greater weight of tan leather is partly due to moisture, and as many tanners frequently produce intentionally thick and heavy leather by a peculiar mode of working, the smaller weight of crown leather would not be against it, and besides which weight and thickness are not a criterion as to the quality of the leather. The greater strength of crown leather is due to the fibrous structure remaining unaltered. In tearing a piece of tan leather the structure is found to be more felty, while in crown leather the fibres lie in their natural position closely pressed against each other. Experiments have shown that crown leather is far superior to tan leather as regards strength. A piece of crown leather ¼ inch thick resisted a pull which tore tan leather ⅜ inch thick. A strip of crown leather about ½ inch wide, ⅛ inch thick, and 2 feet 7 inches long, tore only with a load of 682 pounds, while a strip of bullock's leather tanned with oak bark, and of the same dimensions, resisted only a load of 550

pounds. A strap, consisting partly of crown leather and partly of tan leather, will always tear first in the part composed of the latter.

Crown leather, on account of its strength with less thickness, is especially adapted for the manufacture of machine belts. Such belts being thin and pliable can be placed upon pulleys of small diameter, and are very durable. By using thick leather for belts the fibres on the outside must alternately expand, causing an alteration in the original condition of tension, and consequently formation of cracks. Belts of a single thickness of crown leather are manufactured by simply joining the bevelled ends of the separate strips by means of a plastic mass. Belts for the transmission of greater power are made by placing two, three, or sometimes four thicknesses of crown leather upon each other, and sewing them together. In using these belts the motion is very gentle.

Preller's method requires considerably less time than the ordinary tanning process. Calf-skins can be prepared by two operations in the wheel, each requiring about eight hours with a short interval between the two workings. The conversion into leather of the thickest bullock hide can be accomplished by Preller's process in two and a half days, while under the most favorable circumstances five to six weeks will be necessary by the ordinary method.

As regards the capacity of crown leather to resist water all experiences thus far seem to be favorable. Belts of it used in the open air and damp buildings have stood the test very well.

By boiling ordinary leather in water, it becomes gradually hard and inflexible, and by continuing the operation for half an hour it becomes brittle, or it frequently dissolves and becomes gelatinous. Crown leather subjected to the same experiment approaches gradually to the nature of horn, but only after several hours.

The softness of crown leather makes it very suitable for the soles of house shoes, this quality and its strength with little thickness recommending it also for many other purposes. The back part of horse hides, which in the ordinary method is generally cut off on account of its thickness and not used, can by this

process be brought to such a state of softness, that it can be used together with the rest of the hide. Preller manufactures in this manner beautiful horse leather for carriage tops and boots, which is exceedingly soft and of great lustre.

The theory of the process is easily understood by assuming that the fatty substances used, such as neat's-foot oil, horse-fat, and butter, on the one hand, and bullock's brain and milk on the other, play the same part as in the preparation of Erlanger leather and, that in a certain sense, as is the case in preparing oil leather, the other substances, such as flour containing gluten and starch, and common salt or saltpetre, have no other material function than the same substances in the tawing liquor for alumed leather. But excellent as no doubt the leather obtained by Preller's process is, it cannot be denied that its preparation does not excel in cheapness, and this is the point which every practical man has to consider.

Butter, milk, and flour are commonly too expensive for the manufacturer to expect to be able to cover their cost by the price obtained for the leather produced, and this is very likely the reason why Preller's process has not been more generally introduced.

Preparation of Klemm's Oil-Leather.

This process is, so to say, an intermediate method between alumed and oil leather, alum being used in common with the first, and that of fats with the latter. According to the description given in the patent,[1] the process is as follows:—

a. *Manner of preparing the hides.*—The hides are depilated by liming. A second liming as for alumed or tan leather is not required. To remove the lime, the hides are thoroughly washed and scraped and then placed in the bran steep until all the lime is removed, the raising of the hides being effected at the same time. They are then rinsed in fresh water and scraped clean upon the flesh side.

b. *Tanning* is effected in the following manner: Prepare

[1] Würtemberg'sches Gewerbeblatt, 1855, 9.

warm alum liquor of the proportions previously mentioned, pour it over the hides, and, after thorough treading, allow them to remain in it for twenty-four hours. Then wash and completely remove the excess of alum and salt by treading. Make a paste, composed for one hide of 8.8 pounds of brains, 15.4 pounds of barley flour dust and about $8\frac{3}{5}$ ozs. of cod oil or melted horse grease, and dilute sufficiently with lukewarm water to allow of the hides being drawn through it. After immersion tread the hide until it has completely absorbed the fats and the gluten of the flour. After allowing the hide to remain in the vat overnight, hang it up the next day until it is half dry and then take it on the horse and remove the bran of the flour. After drying completely, and taking it once more on the horse, the leather is ready for coloring. It is suitable for all colors.

By the removal of the alum and subsequent treatment with the tanning paste, this leather on exposure to water does not become fleshy like alumed leather. Beside it combines with all the desirable properties of oil and tanned leather the advantage of being stronger than the best tanned leather in consequence of the texture of the hide not being injured by liming, and that of resisting water better than ordinary tanned harness leather, and being more durable, as it contains no tannic acid.

The further advantages of this process consist in that tanning is effected more quickly and fewer utensils and smaller outlay for tanning materials are required.

Skins of deer, goats, sheep, and chamois tanned by this process combine all the advantages of glacé leather with less consumption of tanning paste.

Prof. Reusch, who made experiments in regard to the strength of this leather as compared with the best harness leather, found the bearing strength of harness leather = 7.100 pounds, of Klemm's oil leather = 13.112 pounds.

The leather is colored in the same manner as glacé leather. After coloring, the hides are once more greased with tallow or fish oil, and then finished with a hot plate.

It will be seen that this process, which corresponds in many points with Preller's, does not differ materially from the more rational methods previously mentioned in speaking of the

manufacture of glacé leather, and it is only natural that it should excel in strength. Prof. Fehling, who has made many conscientious experiments in regard to the matter, finds Klemm's statements entirely correct, and draws especial attention to the fact that Klemm's leather when dried after boiling for 12 hours, showed the perfect cut of the leather, having only become somewhat more brittle.

We have in the chapter on Mineral Tanning drawn the attention of our readers to a method of preparing leather proposed by Dr. F. Knapp, who is well known through his valuable researches in regard to tanning processes. Knapp proposes to effect the tanning by the alternate use of salt solutions and soap baths. For preparing the salt solutions, alumina salts, aluminium sulphate, or alum are employed, or ferric oxide, or chromium salts, the leather obtained by using the last two being of course more or less colored. For practical purposes alumina salts could only be recommended, as they, besides leaving the leather white, have the advantage of being found in commerce of an always uniform quality and great cheapness. Commercial potash-alum is without doubt the best material for the purpose. As regards the concentration of the solution, Knapp recommends 1 part of alum to about 20 parts of water. The soap bath is best prepared by dissolving 1 part of white soft soap in 20 or 30 parts of water. The soft soap, if not otherwise obtainable, can be prepared by boiling good clean fat or tallow with potash lye. The soap bath may also be prepared with ordinary white soda soap, but before using it, it must be heated to 96° to 98° F.

The hides to be tawed by this process, after depilating and preparing them in the usual manner, are placed in the salt solution, and after thorough handling are taken out from time to time and allowed to drain off. This is continued until they are thoroughly permeated with the salt solution, the process requiring, according to the thickness of the hides, and the manner of preparation, 24 to 48 hours. After removal from the salt solution the hides are allowed to drain off, and then, while still moist, placed in the soap solution for 24 to 48 hours, being during this time frequently handled. After removal from the soap bath the hides, which are now thoroughly tawed,

are rinsed in clean water and dried. Finishing and dressing are the same as for ordinary alumed leather. The resulting product corresponds in all respects with that obtained by the ordinary process, but excels the latter in softness and suppleness and greater permanence of the tawing.

According to the same principle, a product resembling in many respects oil or chamois leather, is obtained by treating the thoroughly prepared skins in an acid bath, for the preparation of which hydrochloric acid diluted with 20 to 30 times its weight of water can be advantageously used. The best mode of proceeding, according to Knapp's researches, is first to expose the hide to the action of the acid bath and then place it in the soap solution, repeating the operation twice or three times, or until a cut made in the hide proves it to be thoroughly tawed. After drying, the leather is freed from adhering soap with a sponge.

A more simple and sure method, and one which is at the same time rational and in accordance with the theory of the tawing process, can scarcely be devised. The nature of the method is readily understood.

As soap undergoes an alteration with solutions of aluminium salts, ferric and other salts, and a formation of a more or less voluminous precipitate of sebate or oleate of alumina, iron, etc., which is almost insoluble in water, takes place, it will be readily understood that a complete tawing is effected by the formation of such combination, which by being formed in the skin tissue itself, must envelop the separate fibres of the tissue.

The result obtained by the use of liquors and tawing paste, not very rationally composed, and transmitted to the tawer from remote ages, is by this process reached in a not only more simple but also surer way.

And if we inquire about the expense the answer must certainly be in favor of this process, for nobody can pretend that the tawing paste is cheaper than the soap solution. By trying this process once and seeing the results obtained from it, it will scarcely be possible to understand why this simple and easily managed method has not been more generally introduced,

though known since 1858. Progress in tanning appears to be much slower than in other branches of industry.

A beautiful, white glazed leather of great softness and suppleness, can, according to Knapp, be prepared by macerating thoroughly cleansed skins of lambs or goats in a lukewarm saturated solution of stearine in spirit of wine and drying after thorough permeation. Though we are assured by experiments that this process furnishes an excellent product, especially as regards delicacy of color and suppleness, and a less pure and consequently cheap variety of stearine can be used, it seems to us that the use of spirit of wine as a solvent is too expensive for the purpose, especially as a part of it could only be regained by special utensils and apparatuses. If this defect could be remedied, the process might be used with profit and success.

NOTE.—For matter in this chapter, the author desires to acknowledge his indebtedness to Gintl's *Weissgerberei.*

PART IX.

CHAPTER XLIII.

DYEING LEATHER.

SECTION I. GENERAL REMARKS.

LIGHT is the source of all color, and it is the result of the vibrating motions of a very subtle substance, which the natural philosophers term "ether."

The ether receives vibrations from self-lighting bodies, such as the sun, and spreads them in the same manner as the air spreads sound, with this difference, that the oscillating motions called "light" are brought forth many million times quicker than those of sound, because the ether is many million times finer than the air; consequently, its vibrations are more rapid and intensive.

The light entering our eye excites the optic nerve, producing a sensation called "vision," and thus light renders objects visible.

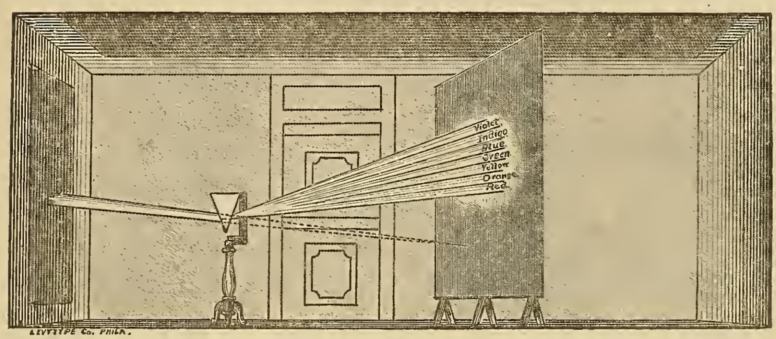
Light itself is not a simple body, but is composed of various colors, of which we distinguish seven by separate names.

All the colors observed in the organic and inorganic world around us are derived by reflection from the different colors, of which the white light, or sunlight, is composed.

When we admit a ray of sunlight into a dark room, and there split it by means of a triangular glass, called a "prism," we can see, upon the screen opposite to the hole, as shown in Fig. 299, a series of bright colors, consisting of violet at the top, indigo, blue, green, yellow, orange, and red. This phenomenon is a "spectrum."

Apparently there are seven colors; but there are only three primitive colors, namely, red, yellow, and blue, from which all others are derived. In fact, if we look very attentively at a spectrum, we soon realize the fact that violet, indigo, green, and

Fig. 299.



orange are the products of amalgamation of either two of the three primary colors, viz., violet and indigo from red and blue, green from blue and yellow, orange from yellow and red. This is, in fact, the only natural explanation of this wonderful phenomenon.

When speaking of primary colors hereafter, it must be borne in mind that we refer to the colors of the spectrum. There exists no primary color substance, that is to say, a color representing nothing but itself, in the true sense of the word. In fact, if we compare all known dye stuffs, we find that they always contain, besides the principal ones, more or less of some other color. This is not, of course, by bodily mixture, but their intimate atomic construction is such as to reflect more or less of the others, too, which are the components of the white light.

For a man who studies the manifestations of nature, all the beautiful colors in which nature dresses plants, flowers, and trees, are simply wonderful objects of admiration. Uncertain colors there are none in the organic world; wherever we turn our eye, we discover harmony and purity in the composition of colors and shades. To imitate this wonderful artist, nature, in coloring, should be the ambition of every dyer.

Of all the arts, none require such thorough knowledge, theoretical as well as practical, as the art of dyeing. Chaptal, the great French chemist, therefore considers the dyer's art as the most useful and admirable of all. Indeed, if there is a calling which could make justly proud the man who practises it as an art, it is certainly that of the dyer.

Chemistry is the abstract science, the part of which in developing the art of dyeing consists in ascertaining, framing, and presenting the invariable rules, upon which all the dyer's operations must be based. The dyer is the practical, artistic executant of these rules; all his operations are strictly chemical. The simplest mixture, the composition of the commonest mordant, involves chemical processes, the knowledge of which is indispensable to insure success. Of all his operations, a dyer should know the result in advance with mathematical accuracy; of his doings nothing should be left to blind haphazard.

The scientifically educated dyer observes; studies facts, always endeavoring to bring the chemical and physical phenomena occurring to him back to scientific principles, in order to ascertain their cause; such studies constituting his experiences, which in all cases serve as guides. Such knowledge allows him to very quietly confront any problem which he may in the course of his operations encounter, giving at the same time an astonishing accuracy to his calculations for the elementary composition, as well as for the production of colors and shades, which he desires to imitate.

In composing our shades, there are, in fact, only the three primary colors at our disposal, that is, red, yellow, and blue. The modifications, which these three colors are capable of undergoing, and the limitless combinations into which they can enter with each other, enable us to reproduce any required color or shade. The part which water plays in all these modifications and combinations makes this element one of the most useful agents in the hands of a dyer. Indeed, water is for the dyer what the white color is for the painter; the more it is used in composing a dye-bath, the lighter becomes the dye; for the dyer, water means "white," that is, absence of coloring.

We shall try to illustrate this assertion by an example, for

instance, a quart of concentrated solution of scarlet. "Concentrated" means that we have dissolved in boiling water so much of the dyestuff as the water was capable of dissolving, and decanted the clear liquor from the sediment, if there was any, after cooling down to 50° F. If leather is dyed with a quart of this solution, there is produced a deep, nourished scarlet; but for the next dye we will take only $\frac{9}{10}$ of a quart of this solution and add $\frac{1}{10}$ of a quart of water, so as to have again 1 quart of dye-liquor. The color thus produced is also well nourished, but has $\frac{1}{10}$ less depth than the former one. The addition of water and the reduction in the quantity of coloring solution have already produced a modification which is not likely to escape a dyer's eye. If we continue reducing the quantity of concentrated solution at the rate of 10 per cent., and increasing the quantity of water at the same rate (that is, making the quantity of dye-liquor = 1 quart), we will arrive at a point where our dye-liquor consists of only $\frac{1}{10}$ quart of the original concentrated solution of scarlet red, and $\frac{9}{10}$ quart water. The color of the material dyed in such a bath is, of course, proportionately lighter. Each time that we have reduced the quantity of concentrated solution of dyestuff by $\frac{1}{10}$, and added $\frac{1}{10}$ more water instead, we have altered the original color, and have produced nine modifications of the first, or ten grades of scarlet-red altogether.

The result of such an experiment is what is called a "graduated line of a color," and each degree of it is called a "modified color" of such a line.

A close examination and dissection of a spectrum discloses the fact that there are not only seven, but actually twelve, colors contained in it, viz: Red at the bottom, and following in successive order upward, red-orange, orange, yellow-orange, yellow, yellow-green, green, blue-green, blue, blue-violet, violet, and red-violet.

If we take three very bright artificial dyestuffs (red, yellow, blue), products of coal-tar, better known as aniline colors, whose chemical composition allows of their perfect union by mixing their solutions with one another, we can produce these twelve colors of the spectrum by mixture, out of three we can form twelve, nine of them being binary colors, so called from being

composed of two of the three primary colors. There is no difficulty in producing such a representation of a spectrum upon leather.

The measure is for a leather dyer what scales and weights are for the chemist—they are proof and evidence. A quart represents a unit, which can be divided, and of which we can take only one hundredth part or any fraction we desire or require—where figures corroborate, error is not probable. One quart of concentrated solution of scarlet-red is mixed with one quart of concentrated solution of a yellow dyestuff. If these dyestuffs represent the true elementary colors, and this bath is applied to dyeing leather, properly prepared, the product must be a true orange, this color being composed of red and yellow in equal proportions. But if only 0.25 of a quart of yellow dyestuff solution is mixed with 0.75 of red, the compound will be red-orange. If, on the other hand, these proportions are reversed, that is, 0.25 of a quart of red dye-liquor mixed with 0.75 of yellow, the product will be yellow-orange. As red and yellow in equal proportions form the true orange, it follows that red-orange lies on one side of this binary standard color (toward red), and yellow on the other (toward yellow). We call a "binary standard" that compound color which is obtained by mixing together the liquors of two primary colors in equal proportions.

By operating in the same manner with the solutions of a yellow and a blue dyestuff, yellow-green, green, and blue-green are produced.

The solution of a true blue dyestuff, such as is spoken of in enumerating the prismatic colors, being brought together with that of a pure red, in the above proportions, the blue-violet, violet, and red-violet of the spectrum are produced.

It should be borne in mind, however, that in all cases the dyestuffs which are used for such operations must be of such a nature as to allow of their combination, that is, of their perfect embodying one into the other, if mixed in solution; so that, after dyeing, no separate colors can be distinguished upon the material.

If in the transition from one prismatic color to another we were at each step to exchange only one hundredth part of the

one for an equal quantity of the other, it is evident that infinitely more colors might be produced; but these slight modifications would be hardly distinguishable. To our eye the whole scale would appear as an amalgam, like the spectrum of the white light. But if it is considered that either of the two colors can be graduated, that is, progressively changed from very dark, nearly black, to light and very light, nearly white, it may readily be imagined that thousands of colors can be produced by this very simple means. We say purposely colors, because we mean not shades, of which we shall speak later.

The slightest alteration of white is at once perceptible; while a considerable proportion of any other color can be added to black, before the modification becomes apparent to even the trained eye.

Transition of colors through their countless modifications can be very properly illustrated by a so-called color-ball, having for its equator, as it were, a zone consisting of the primary and binary colors, white for its north pole and black for its south pole.

But to return to our circle of normal colors: All colors growing out of a primary color must be classed under that denomination, until they reach the compound of the primary with the nearest binary standard color. For instance, all colors originating in red are to be classed as reds, until the red-orange is reached, with this difference, however, that they are distinguished at first, second, third, etc., reds, according to the degree of modification the red has undergone. Thus, if red is denominated as No. 15 on the side toward blue, it would signify that this red contains 15 per cent. of blue; as only with the addition of 25 per cent. blue the red becomes red-violet. The same nomenclature ought to be used for blues and yellows.

From the above it is easy to see that a precise knowledge of this circle is sufficient to determine a color at once, thus enabling the dyer to reproduce it. The series of modifications of which any primary or binary color is susceptible is collectively called the "category" of that color, and we wish it here to be understood that the category is not identical with "shades," though

the erroneous application of this term is quite general and popular. We know what a simple (or primary) color is, of which there are only these three: red, yellow, and blue; we know also, that either two of these simple colors combined with one another form a binary (or secondary) color. But a "shade" is the result of the combination of one binary color with one or two other binary colors not belonging to the category of the former.

Brown, for instance, is a shade. All the browns are oranges shaded more or less with blue or violet. When a dyer is called upon to reproduce a certain brown, the first thing he has to do is to ascertain what kind of orange is the base of it, whether red, pure, or yellow orange. By contrasting various browns with another, it is easy to determine whether the particular brown in question belongs to the reddish or yellowish category; the category once defined, there is no further difficulty in deciding upon the base of the dye-bath, whether reddish or yellowish-orange. This base is then to be composed, then to be shaded, and the bath is ready for dyeing; if the diagnose of the orange is correct, and the shading carefully done, the dyer cannot fail in producing the exact brown.

From this it may be seen how indispensable for a dyer it is to thoroughly understand his binary colors; upon this knowledge depends, in fact, the whole art of producing the various shades. The whole variety of binary colors are so many bases for all imaginable shades.

The shades, in their turn, are again susceptible of infinite modification, that is, of being rendered light by the addition of water, or darkened by the chemical action of various salts, such as sulphate of copper, bichromate of potassium, etc., added to the dye-bath. The whole range of such modifications, from the lightest to the darkest hue, is called the "category of a shade."

In reproducing a given shade, the practical dyer will rather from the beginning sadden a little less than too much, because he has it always in his power, and it is easier to increase the saddening, than to diminish it, after it has been once produced.

The manufacture of dye-stuffs from coal-tar, the so-called aniline colors, has attained a high state of perfection, although

this fruitful field of manufacturing chemistry is, as yet, only partly explored and still less practically cultivated; and we are daily greeted by the news of improvements, inventions, and new and astonishing discoveries in this line. There are now already a number of such artificial dye-stuffs in the market, which directly produce a variety of desirable shades, relieving the dyer of the trouble and the cost of experiments to compose them. Still, it is very often necessary to mix these colors for the production of certain shades. In such cases it ought to be borne in mind that the base of every shade is a binary color, which must be ascertained and defined before beginning the mixing operation, in order to save trouble, time, waste, and positive loss. Dyeing with aniline colors will be enlarged upon in Section V. of this chapter.

Section II. Mordants.

Mordants in the widest sense are bodies having the power of fixing certain coloring matters upon materials to be dyed. But in the narrower sense mordants are also certain bodies which possess the power of changing the natural color characteristic to coloring matters, thus leading to the production of several shades with one and the same substance. In as far as many bodies available as mordants can produce, on meeting with other substances partly organic and partly inorganic, characteristic colors, they may be designated as color-yielding substances.

The mordants generally used can be divided into three groups, viz., acids, bases, and salts.

Acids.

Acids are generally compound bodies sour to the taste, and capable of changing blue vegetable colors to red. By combining with bases they furnish combinations which have neither the external characteristics of the acid nor those of the base combined with it, in fact are new bodies. Such combinations of acids with bases are called salts. In the process of combination the acids are neutralized by the bases, the same being true in a

reverse sense as regards the bases. Acids are divided into mineral and organic acids.

Sulphuric, nitric, and hydrochloric acids are the principal mineral acids employed in dyeing leather, and they will be described separately.

Sulphuric Acid,

or oil of vitriol, is a combination of sulphur with oxygen. In a concentrated state it is a caustic substance, which energetically attacks organic bodies and destroys them under a black or brown coloring, and is best kept in glazed earthenware or glass vessels hermetically closed. Sulphuric acid is mixable with water in all proportions, and by sufficiently diluting loses its strong caustic property and yields a fluid more or less clear. Diluting the acid with water requires to be done carefully, as the great attraction which this acid has for water causes a strong development of heat, in consequence of which phenomena resembling explosions of steam take place, and with careless handling the workman might be injured by the caustic fluid. Many have suffered permanent injury to health or have lost eyesight by carelessly diluting sulphuric acid. With the exception of dissolving indigo, which requires concentrated sulphuric acid, only dilute sulphuric acid is used in dyeing leather. The best method of diluting is to place the water in a clay or porcelain vessel, or very diluted acid in a wooden vat, and to pour the concentrated acid into it in a thin stream, a glass rod being used to mix the acid with the water as it flows in. Under no circumstances should water be poured into concentrated acid.

Nordhausen, or fuming sulphuric acid, differs from common sulphuric acid in its mode of preparation and that it contains less water, and is in a certain sense more concentrated than ordinary sulphuric acid, which is due to its percentage of anhydrous acid. For all other purposes except for dissolving indigo, the use of Nordhausen sulphuric acid would be sheer waste, as the cheaper American acid, when diluted with water, furnishes the same product as fuming acid, and besides has the advantage of being less contaminated.

Nitric Acid

Is a product of the action of sulphuric acid upon nitrates, and is generally prepared by distilling nitrate of potash or of soda with sulphuric acid. The strongest nitric acid emits thick gray fumes when exposed to damp air, because its vapor, though itself transparent, readily absorbs water from the air, and condenses in minute drops of diluted nitric acid which compose the fumes. Nitric acid exerts an energetically oxidizing influence upon all organic substances, and is best kept in vessels of glass or earthenware. It is mixable with water in all proportions, and in a diluted state furnishes a colorless fluid of a strongly acid taste.

Nitric acid suffers decomposition when exposed to the light, and it frequently happens that bottles filled with concentrated nitric acid burst on exposure to light, in consequence of the pressure of the accumulation of gases in the upper part of the bottle. Such acid, decomposed by the action of light, assumes a red-brown, and under certain circumstances, green color, and acquires the property of emitting, when exposed to the air, brownish-red vapors of hyponitric acid, etc., which violently irritate the respiratory organs. Such acid, known as red or fuming nitric acid, is very serviceable for certain purposes, and is especially manufactured and brought into commerce.

Ordinary, as well as fuming, nitric acid is exclusively used by the dyer for sharpening certain baths, and in the preparation of some mordants; for all other purposes it can be replaced by other and cheaper acids. The characteristic property of nitric acid of coloring nitrogenous, organic substances, yellow, which is utilized in silk and wool dyeing, cannot be made use of in coloring leather, as the acid would act too strongly upon the leather substance.

Hydrochloric Acid

Is a solution of the gaseous combination of chlorine and hydrogen in water, and is a yellowish fluid which emits white fumes when exposed to the air, and has a suffocating odor. It is

mixable with water in all proportions, and when sufficiently diluted yields a colorless fluid of a perceptibly acid taste.

On account of its cheapness, hydrochloric acid can be advantageously used where only the action of an acid is required, as, for instance, in neutralizations, etc.

Of *organic acids*, the following are of interest to the dyer:—

Acetic Acid

Is found in nature as a constituent of salts, occurring in some juices of plants, and also forms a constituent of certain combinations of the animal body. It is a combination of carbon, hydrogen, and oxygen. Very concentrated acetic acid is slightly caustic, but diluted with water it is entirely innoxious.

Pyroligneous acid—obtained by the dry distillation of wood, and as a by-product in burning charcoal—is dilute acetic acid. It is much used, especially for dyeing leather, in consequence of its containing certain empyreumatic substances. It possesses the property of imparting to the black color, produced with the assistance of the so-called black vat, a pure tone of color, this being the reason why it is almost exclusively used for iron liquor for black.

Acetic acid, whether produced by the oxidation of alcohol, or dry distillation of wood, is mainly used for the preparation of the various acetates employed in dyeing, and as it attacks the leather substance less energetically than mineral acids, is preferably used for acidulating dye-baths.

Oxalic Acid,

Known also by the name of acid of sugar, is, like acetic acid, a combination of carbon with hydrogen and oxygen. It is a constituent of many plant juices, being found in the leaves of the wood-sorrel, in the stalks of rhubarb, in some seaweeds, and in certain lichens. Oxalic acid, like acetic acid, is used for preparing dye-baths. It is very poisonous, the antidote being chalk of magnesia.

Citric Acid and Tartaric Acid.

Citric acid is a constituent of plants, and occurs in the juice of lemons, currants, gooseberries, and other kinds of fruit. Tartaric acid is prepared on a large scale from crude tartar, which is deposited in wine casks. Both acids are occasionally used as additions to dye-baths, though they probably possess no special virtues entitling them to preference before the other acids. In commerce both acids are found in the form of colorless crystals, or crystalline masses, readily soluble in water, and yielding solutions of a pure acid taste.

Bases.

Bases comprise all compound bodies capable of combining to salts with acids. Bases soluble in water have in common the property of re-coloring vegetable substances blue after its color has been changed to red by acids. Considering bases in the above sense that they can combine with acids to salts which show neutral reaction under certain circumstances, we may speak of a neutralization of acids by bases and employ them for that purpose. The majority of bases, which are either metallic oxides (mineral bases) or combinations containing nitrogen, hydrogen, and carbon, and sometimes oxygen (organic bases), are insoluble in water but soluble in acids, while, on the other hand, bases with insoluble acids and soluble in water will generally yield solutions containing the newly formed salt. On account of the dissolving effect which bases exert upon many insoluble substances by reason of the nature of the acids, they are as such of but little importance to the dyer. These are the following:—

Potassium Hydrate and Sodium Hydrate.

The first body is almost exclusively obtained by the action of caustic lime upon solutions of potash. It dissolves very readily in water, has a strongly alkaline reaction, and exerts a powerful caustic effect by reason of its capability of dissolving many organic

substances (among others animal skin). Caustic potash can generally be replaced by the cheaper potash, soda, or ammonia.

The action of sodium hydrate, or, as it is commonly called, caustic soda, is very similar to that of caustic potash, and is frequently used as a substitute for the latter substance, which it resembles in appearance.

Ammonia.

In a pure state ammonia is a colorless gas of a pungent odor. It is a combination of nitrogen and hydrogen, and is produced by heating a mixture of caustic potash or caustic soda, or, what is cheaper, caustic lime, with sal ammoniac.

Although ammonia is a cheap article of commerce and is in general use in dyeing, urine of human beings and of carnivorous animals is almost exclusively used in the so-called English method of steam dyeing. Besides there are other dyers opposed to progress who still make use of antiquated receipts and retain the disgusting use of urine, although the employment of ammonia is not only cheaper but also better. We consider it unnecessary to enter into a discussion of this antiquated substitute for ammonia, and will only remark that putrefied urine can only be used as it only acquires the properties of a substitute for ammonia in that state. Urea, a characteristic constituent of the urine of carnivorous animals, undergoes decomposition in the putrefaction of urine, in consequence of which ammonium carbonate, *i. e.*, the active principle of putrefied urine, is formed.

Lime.

Caustic lime, or burnt lime, is the oxide of calcium. The purest product is obtained by burning white varieties of marble, while ordinary limestone yields lime contaminated with alumina, silicious earth, iron, etc., the quality of the lime depending on the quantity of these impurities. The fewer impurities lime contains, the better it is for dyeing purposes. Lime-water, or milk of lime, is much used, not only for neutralizing purposes, but also for separating acids from solutions; the preparation of caustic lyes being, for instance, a process in which the power of lime of precipitating carbolic acid in the form of insoluble

carbonate of lime is utilized for separating the carbonic acid from the oxides of potassium or sodium.

Other bases by themselves are not used in dyeing, only the combinations of a few with acids, *i. e.*, their salts, being employed.

Organic bases, which are generally derivatives of ammonia, and closely allied with it, are also not used by themselves as mordants, though in certain combinations they furnish highly valued coloring matters.

Salts.

Salts are combinations of acids with bases, no matter whether the acid or the base is of organic or vegetable origin. The salts can be divided into acid, neutral, and basic salts, according to whether their acid is incompletely or completely neutralized, and the base is also completely neutralized, or whether a non-saturated part of the latter is present in excess. Acid salts are such as contain an excess of acid, basic salts, such as contain an excess of base, while the term neutral salts is applied to those which contain exactly the quantity of base necessary for the neutralization of the acid. Soluble acid salts have generally an acid reaction, and basic salts mostly an alkaline one, while the majority of the actually neutral salts have also a neutral reaction. Exceptions to this rule seldom occur.

While the actual salts consist, as stated, of acid and base, and are, therefore, oxygenous combinations, there is another class of salts which contain no oxygen, and must be considered as pure combinations of metals with another element or with a combination. They are called haloid salts, chlorine, bromine, iodine, etc., being instances of this class. One of the most common examples of these salts is common salt, which is composed of the metal sodium and the element chlorine, and is, therefore, chemically known by the term sodium chloride.

In the following we give a compilation of salts of greatest importance to the dyer.

Sulphates.

Ferrous sulphate, or *green vitriol*, is a combination of ferrous oxide with sulphuric acid. It is used for making mordants,

especially for black, gray, and violet, and for preparing the indigo vat. For the latter purpose, it should be as pure as possible, while for preparing iron liquor, ferrous sulphate, even if turned strongly brown, can be employed. It is also used in the production of Berlin blue.

Cupric sulphate, or *blue vitriol*, contains cupric oxide and sulphuric acid, besides water. It is brought into commerce in transparent or semi-transparent prisms of a dark-blue color, which have an acid metallic taste. They are soluble in 4 parts of cold water and 2 parts of boiling water.

Under the name of Salzburg vitriol, double eagle vitriol, etc., a variety of cupric sulphate is brought into commerce, which, besides being mixed in various proportions, contains sulphate of zinc. Both varieties are used in dyeing glove leather.

Cupric sulphate is very poisonous; a small quantity taken inwardly produces severe vomiting.

White vitriol, or *zinc sulphate*, is a combination of oxide of zinc with sulphuric acid, and is obtained by crystallization from a solution of zinc in dilute sulphuric acid. The crystals are clear as water, and have a nauseously metallic taste. They are readily soluble in water. White vitriol, which is very poisonous, is almost exclusively used in the so-called English method of steam dyeing.

Aluminium sulphate consists of sulphuric acid and aluminium. It is found in commerce in the form of bricks or plates of a white or grayish-white color and an acid taste. By boiling aluminium sulphate with water, it is gradually and completely dissolved, and yields a colorless fluid, with an acid reaction. The solution can be advantageously used in all cases where alum was formerly employed, especially as it contains no excess of sulphuric acid, and constitutes the only component part of alum which makes the latter valuable for dyeing purposes.

Alum, in the narrower sense of the word, is such a double combination of two sulphates, which will always contain aluminium as a sesquioxide, when solutions of aluminium sulphate are brought together with sulphates of suitable simple oxides. According to the nature of the sulphate combined with the aluminium sulphate, the following principal distinctions are

made in the varieties of alum: Potash-alum, ammonia-alum, and soda-alum. Soda-alum is more readily soluble in cold water than the others. For dyeing purposes potash-alum is most generally used, or as a substitute for ammonia-alum, or a mixture of both in varying proportions. It is of little importance which variety is used, only in buying his supply the dyer should be careful not to be overcharged by paying the same price for ammonia-alum, which is always cheaper than potash-alum. For the purpose of recognizing whether potash-alum is pure, rub a piece of it together with caustic lime and moisten the mixture with water. The presence of ammonia will be readily detected by its characteristic odor. It is also worthy of consideration that alum frequently contains iron, which renders it unsuitable for many purposes, as the percentage of iron frequently produces with the coloring matters other shades than those intended. In order to obtain a pure red with madder, alum containing iron must be especially avoided. It is, therefore, well to subject the alum to a test before using it. This is readily effected, according to Prof. Runge, by throwing a piece of the alum to be tested into a solution containing 15½ grains of potassium cyanide in 7 ounces of water. If the color of the surface of the alum remains unchanged, it is *free from iron*, but *contains iron* in case blue spots make their appearance. This test is entirely reliable for alum in pieces; it is claimed to be equally reliable for pulverized alum and alum solution.

A variety of potash-alum which is especially highly esteemed is the so-called cube alum. It is distinguished from the ordinary alum by the form of its crystals, and has the further advantage of its solution being entirely free from iron.

"Burnt alum" is almost exclusively used for fixing coloring matters which by themselves have not sufficient capacity to adhere to the fibres. But it is not generally used in the above form, but rather by preparing first a solution in which by adding acetate of lead to alum solution, aluminium is present as aluminium acetate, and using the solution as a mordant (red liquor).

Chromium alum is also sometimes used for dyeing purposes, especially in dyeing with aniline colors. It is found in com-

merce in dark violet crystals, which yield with water a solution of the same color. On heating, the aqueous solution turns green, but gradually reassumes its original color.

Nitrates.

Ferric nitrate and lead nitrate are the only ones of the series which have any importance for the dyer.

Ferric nitrate is formed by dissolving iron in nitric acid. The commercial article is a brown liquid of the consistency of syrup, has an acid reaction and a strong taste of ink. It is mixable with water in all proportions, the diluted liquid yielding a strongly colored fluid. This salt, which can also be prepared in a solid form, can be advantageously used for black and blue colors, in the latter case with the assistance of yellow prussiate of potash.

Lead nitrate is prepared by dissolving litharge in nitric acid. It forms white crystals of a nauseously metallic taste, which are difficult to dissolve in cold water, but readily so in boiling water. Lead nitrate, like all other soluble lead combinations, is poisonous. This salt, which is not generally used in leather dyeing, lead acetate being mostly substituted for it, has only become of importance since the introduction of aniline colors.

Chlorides.

Sal ammoniac comes into commerce either in fibrous cakes (sublimated sal ammoniac) or in small crystals (purified sal ammoniac). It is readily soluble in water, and yields a colorless solution of a neutral reaction and a peculiar salty taste. In dyeing it is used as an addition to the so-called tin composition.

Ferric chloride is similar to ferric nitrate, and is used in a like manner.

Stannous chloride (tin salt) is of but little importance to the leather dyer, as leather, especially alumed leather, is not improved by it.

Stannic chloride forms the most active constituent of the solution of tin in nitric and hydrochloric acids, or in nitric acid and sal-ammoniac, which is known by the name of *tin composition* or *physic.* Pure stannic chloride is soluble in water, and yields

an almost colorless solution of a strongly acid reaction, which can be successfully used as a substitute for all the various tin compositions.

Common salt (sodium chloride) is so well known that it requires no description. It plays a more important part in tawing than in dyeing.

Acetates.

Ferric acetate in a pure state forms a reddish-brown liquid of an ink-like taste. It is never used in this form for dyeing purposes, but it constitutes the active principle of the various essences used under the name of iron liquors, which are obtained by dissolving iron in vinegar, sour beer, sour wine, or wood vinegar. The following directions for the preparation of a black vat can be recommended: Place a barrel upright and provide it with a perforated false bottom six inches above the true one. Upon the false bottom pile a layer of old iron or iron filings, and upon this a layer of iron, which should be rusted as much as possible. Upon the iron place a layer of young alder bark with the addition of a few nutshells and a few buckthorn berries. Upon this bring another layer of old iron, upon this a layer of alder bark, nut-shells, and berries, and continue the layers alternately until this barrel is full, and then fill the barrel with an acid liquid such as vinegar, sour beer, juice of unripe fruit, etc. The first liquid is generally heated before pouring it into the barrel. A part of the fluid is drawn off from time to time through a cock near the bottom of the barrel and poured back over the material, whereby a movement is originated in the barrel which exerts an advantageous effect. Some leather dyers use, besides the above-mentioned materials, some verdigris, which has by no means an injurious effect.

The black vat cannot be successfully used before it is six months old, and can only be called good after it is one year old. The black vat is not only used for dyeing oil leather, but also for coloring alumed leather upon the flesh side. The iron solution prepared in the above manner is, as a rule, something over 2° B.

Aluminium acetate forms the actually active constituent of the

red liquor, which is generally prepared by mixing hot solution of alum, or better of aluminium sulphate, with plumbic acetate. The resulting solution, which is as clear as water, can be immediately used after adding some sodium sulphate in order to completely separate the lead. According to Leussen, the following are the best proportions: Dissolve 191½ pounds of aluminium sulphate and 15½ pounds of soda in 37 gallons of water, and add to this solution a solution of 228¾ pounds of plumbic acetate in 18½ gallons of water. After settling and removal of the white precipitate of plumbic sulphate by filtering, the mordant can be immediately used. Aluminium acetate is an indispensable mordant for the calico dyer, but is of less importance in dyeing alumed leather since the skins, on account of the percentage of aluminic salts worked into them by the tawing process, do not especially require a mordant. In dyeing oil leather this mordant can be advantageously used.

Plumbic acetate (sugar of lead) is prepared by dissolving litharge in vinegar and evaporating the resulting solution. It is chiefly used for preparing the red liquor and for the production of chrome yellow upon leather. For the latter purpose it is better to use the basic acetate of lead, it being less injurious to the leather. It is prepared by boiling solution of plumbic acetate with an excess of litharge and is found in commerce in solution under the name of vinegar of lead. Both salts are violently poisons, and when taken inwardly or even handled carelessly produce symptoms of colic.

Cupric acetate. In commerce this salt is known as verdigris, crystallized verdigris, distilled verdigris, etc. It is but slightly soluble in alcohol and requires five times its weight of boiling water for a complete solution. It forms bluish-green crystals of a nauseously metallic taste, which represent the actually neutral salt, *i. e.*, the crystallized or distilled verdigris.

Under the general name of verdigris a basic acetate comes into commerce in two varieties differing widely in appearance. One forming a mass of a pale blue color sprinkled through with a quantity of crystalline spangles, while the other is a greenish mass in which the crystalline spangles are less perceptible and

have a more earthy appearance. The difference in appearance is caused by the presence of different basic salts.

Verdigris can be used as a substitute for crystallized verdigris in all cases, it being only necessary to use a larger quantity of it, or, what is preferable, to dissolve it with an addition of acetic acid which effects a ready and complete solution. Independent of being the material used for the manufacture of Schweinfurth green, verdigris is only used as a mordant in dyeing with garancine or as a ground for the production of brown shades in dyeing with potassium ferrocyanide.

Tartrates.

Of this series of salts, the only of any importance to the dyer is the *potassium bitartrate.*

It forms a crust in the fermenting vessels, and after reaching a certain degree of thickness is broken out and brought into commerce as *crude tartar.* It forms grayish-brown masses, which, when derived from red wine, have a dirty red color.

Cream of tartar is found in commerce either as colorless, transparent, and hard crystals, or as a powder. It dissolves in 200 parts of water of 158° F., and in 20 parts of water of 185° F. It is insoluble in alcohol.

Tartar is used in leather dyeing for the purpose of increasing the durability of the colors. Tartar used at the same time with ammoniacal liquids gives a good mordant.

The chemical action of tartar in the different dyeing processes is not yet thoroughly explained. Its power of keeping lime salts and many metallic oxides in solution, is of especial importance as a protective against the injurious effects of hard water which has frequently to be used, and exerts a disturbing influence upon the progress of the dyeing process on account of its richness in lime salts.

Carbonates.

Of this series of salts only two are of importance to the dyer:

Potassium carbonate (potash) is almost exclusively obtained by lixiviating wood ashes and evaporating the resulting lye. It forms a mass of a dark-gray, blue-gray, or bluish color, which

readily becomes moist on exposure to air and deliquesces. It is easily soluble in water, yielding a solution of a lye taste and strongly alkaline reaction (crude potash). Purified potash, on the other hand, is always white and also soluble in water. Different varieties of potash are known in commerce and designated by various names according to their quality and derivation, such as *pearl ash*, *Russian potash*, *Illyrian potash*, *American potash*, etc.

As potash is always used in solution it is recommended that the dyer subject it to the inexpensive purifying process, which consists in pouring over it about the same quantity of water. The carbonate passes into solution, and by placing the vessel in the air and pouring off the solution, it can readily be separated from the larger portion of sulphates and chlorates which form the most common contaminations. The residue is washed out with water, which can be used for purifying a fresh quantity of potash.

Potash is partly used for cleansing the skins before dyeing, and partly as an addition to aluminium sulphate whereby the sulphuric acid is saturated. It serves also to remove any excess of oil used in preparing many skins and frequently for the neutralization of acid liquids, whereby effervescence, caused by the escape of carbonic acid, takes place. Potash is also used as mordant in the English method of dyeing glove leather.

Sodium carbonate (soda) is used by the dyer chiefly for neutralizing purposes, for dissolving coloring matters, and as a constituent of mordants. In most cases it can be employed as a substitute for potash.

It remains to mention a few salts of other acids of importance to the dyer which could not be included in the above groups.

Potassium bichromate is composed of chromic acid and potassium. This salt, which is very poisonous, is chiefly used with dye-woods for the preparation of black colors, the development of which from the coloring matter of the dye-woods is due to the oxidizing action of the chromic acid. By mixing potassium bichromate with lead salts (nitrate or acetate of lead in solution).

Lead chromate is obtained as a yellow, pulverulent precipitate, which is highly esteemed as a color (chrome-yellow). In dyeing

leather it is most conveniently used by subjecting the leather previously mordanted with lead acetate to the action of a solution of potassium chromate.

By heating potassium chromate with concentrated sulphuric acid, a green solution is obtained from which separates the previously described chrome-alum in the form of crystals.

Yellow prussiate of potash (potassium ferrocyanide) is brought into commerce in the form of yellow crystalline masses more or less saturated, which yield a white powder. The salt is readily soluble in water, especially if previously heated, and is distinguished by its bitter salty taste and neutral reaction. It is not poisonous. Yellow prussiate of potash is not used as much as a mordant for fixing other colors, as for a coloring matter by itself, since it possesses the power of yielding at once a beautiful blue color, known as Berlin blue, on coming in contact with iron salts.

This blue, which can also be prepared by the action of yellow prussiate of potash upon sulphate of iron and simultaneous exposure to the air, is convenient for dyeing leather, since nothing further is required than brushing the skins previously mordanted with yellow prussiate of potash with a weak solution of nitrate or acetate of iron, or, *vice versa*, treating skins mordanted with iron solution with yellow prussiate of potash. Another somewhat different method of dyeing with Berlin blue is to saturate the articles to be dyed with a solution of ferric salt and ammonium oxalate (obtained by saturating oxalic acid with ammonium), to treat them next with prussiate of potash, and finally to pass them through a weak acid bath. Berlin blue prepared according to any of the above methods is entirely fast, and is not changed by acids, but is destroyed by alkalies. The coloring matter is, however, not soluble in water. With prussiate of potash and a cupric salt, a beautiful brown is produced, the formation of which is due to the precipitation of cupro-ferric-cyanide upon the leather.

Red prussiate of potash (potassium ferric-cyanide). This compound crystallizes in large, dark-red, monoclinic crystals soluble in water with a brownish-green color. It is poisonous. Its employment in dyeing is due to the fact that with ferrous salts,

it yields a blue, the so-called Turnbull blue, which is similar, as regards behavior and appearance, to Berlin blue. It is an excellent oxidizing agent especially in the aniline color industry, where it is chiefly used for the preparation of aniline black. For producing blue colors the cheaper yellow prussiate of potash is, however, to be preferred.

It only now remains to mention in a general way the substances which can be obtained by the action of alkalies upon fats and oils, and which are known as

Soaps.

The product of saponification, which is known as soap, must be classed with the salts.

Soap of every kind, and especially that used in dyeing, which result from the saponification of a fat or oil by an alkali, must chemically be considered as a mixture, more or less pure, of the stearate, palmitate, and oleate of the alkali used, containing besides water and frequently an excess of alkali and some glycerine.

Soaps are generally divided into potash and soda soaps according as the fat has been saponified with potash or soda. Potash soaps are generally soft and readily soluble in water, and soda soaps hard and more difficult to dissolve. A further difference in the quality of the soap depends on whether the soap is separated by the addition of salt or prepared by simply evaporating the solution obtained by boiling the fat with the alkali. Soaps have the peculiarity of being precipitated from their solutions in water by an addition of common salt, and this peculiarity is taken advantage of, by throwing into the boiler a quantity of common salt, in order to separate the soap from the lye. The soap rises to the surface when the spent lye is drawn off and the soap is brought into a solid form either by further boiling or by being transferred to iron moulds. Independent of the fact that such soaps are generally soda soaps, they have the advantage of being purer than soaps not separated by salt, and are especially free from an excess of alkali.

Generally speaking, good hard soda soap is the best to be used for dyeing purposes, it being only necessary to see that it is as

white as possible and not too strongly alkaline. The variety known as Marseilles soap, which is a combination of olive oil and soda, and also the finer grades of white castile soap, can be especially recommended. A good quality of tallow soap or palm-oil soap can also be used with equal success.

In dyeing leather soap is partly employed for preparing the skins to be dyed, and partly for giving lustre to the dyed leather.

Section III. Mechanical Work of Dyeing Alumed Leather and Directions for Preparing and Applying Various Vegetable Dyes.

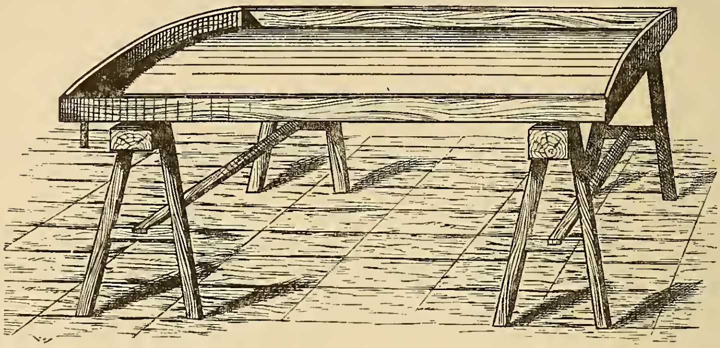
Glove leather is dyed either upon the flesh side or upon the grain side. The latter process, which is the usual one, is executed either by dipping or painting.

In order to obtain uniform coloring the skins must in all cases be cleansed, *i. e.*, uniformly moistened by fulling in a drum or treading in lukewarm water. For this purpose the skins are placed in a vat with sufficient warm water to allow of their being thoroughly worked, and trodden with the bare feet of a workman, until they show no white spots. As by this treatment they lose a part of the egg substance and flour previously imparted with the tawing paste which has been described in the preceding chapter, it is restored either only with yelk of egg (1 yelk for each skin) or with an addition of flour (100 yelks of eggs and $2\frac{1}{4}$ pounds of flour for one gross of skins). If several lots of skins are to be cleansed in succession, a saving of yelk of egg is effected by adding warm water to the liquor remaining from the first lot and using it for treating the second lot, and so on.

Dyeing the skins upon the flesh side.—After brushing whiting upon the flesh side the skins are smoothed with the hone. They are then cleansed, wrung out and after drying worked with the stretcher. The skin is then spread upon a table with a bed of zinc, such as is shown in Fig. 300, and the color applied as uniformly as possible with a long bristled brush. Immediately after applying the color the skin while still moist is stretched in

a frame and pumiced. In executing this operation the workman holding the lower end of the skin with the left hand rubs with the right from top tc bottom, pressing the pumice-stone as hard as possible upon the skin. After turning the skin and pumicing the portion not touched in the first operation, the skin

Fig. 300.



is dried in damp weather in a heated room. After drying and working with the stretcher it receives a second application of color and is again dried and worked with the stretcher. Should the color not be sufficiently intense, a third application is required.

The skins being already sufficiently mordanted by the alum contained in them, the only requisites for dyeing are simple decoctions of dye-woods, barks, and berries, such as logwood, Brazilwood, Avignon berries, quercitron, etc., which are compounded for the different shades. A chestnut color is obtained by a decoction of fungi, such as grow on the trunks of apple and pear trees, prepared by breaking the fungi into small pieces, and after soaking them over night in water, boiling in water for two hours, and repeating the boiling in fresh water.

To impart a black color the skins, after working them with the stretcher, receive a coat of iron liquor (acetate or methylate of iron) of about 2° B., and, after drying, a strong application of logwood decoction, and, finally, one of acetate of iron. Pumicing is omitted. To oxidize the iron the skins are exposed to the air for a few days and then brushed with a brush moistened

with pure olive oil or almond oil, in order to give the black color the required lustre. To avoid spots, moisten the palm of the hand with the oil, and after passing it over the brush, take the oil from this brush with a second, and rub the oil into the skin with the latter.

To prepare by this method of dyeing alumed leather, an imitation of Swedish leather, apply, after cleansing the skins, a color of oak bark, decoction of fungi, and Brazil-wood, and after giving yelk of egg, stretch, dry, and work them with the stretcher. Then apply the second coat of color, stretch, and work them with stretcher, and finally brush the leather upon the flesh side.

Dyeing the skins upon the grain side.—For glazed leather and glazed glove leather the skins are first sorted into different classes, the finest and whitest being reserved for white gloves, while the others are selected for light or dark colors, according to the cleanness of the grain. The skins are prepared in the same manner as those to be dyed upon the flesh side.

Dyeing by Dipping.

To dye glazed skins by dipping, pour after cleansing and taking the skins from the vat, one-third of the dye-bath, the temperature of which should not exceed 77° to 86° F., into a vat, and work the skins in it with the hands to make the absorption of color uniform. Then beat them with the feet until the color of the bath is exhausted. After ten minutes remove the skins from the vat, and after pouring in the second third of the dye-bath, proceed in the same manner as before, and after that with the last portion of the dye-bath. Including cleansing, dyeing is accomplished in less than an hour. The remaining dye-bath is poured into a vessel and used for another color. The dyed skins, after treating with yelk of egg, wringing out, swinging in the air, and stretching, are suspended by the lowest ends of the hind shanks, and quickly dried.

As the flesh side is also dyed by dipping, this process is generally only used for delicate and light colors. Berries are still often used as a dye-stuff. For yellow Avignon berries, for gray dwarf elderberries, for sea-green privet dog-wood berries, and

for other green shades buckthorn berries. Very dilute decoctions of dye-woods are also used. For canary-yellow weld, for rose color Brazil-wood, for lilac logwood, and for other shades mixtures of these decoctions. A peach color is, for instance, prepared by boiling 1 pound 2 ounces of Avignon berries, $2\frac{1}{4}$ ounces of ground Brazil-wood, and 1 pound 2 ounces of dwarf elderberries in 21 pints of water for two hours. It is not advisable to use astringent substances, such as quercitron, sumach, oak tan, etc

Dyeing by Painting.

Dyeing glazed leather by painting can be accomplished either according to the *Grenoble* or the *English* method.

By the Grenoble method the skins are first cleansed, *i. e.*, soaked. After removal from the cleansing water they are placed upon a smooth board and smoothed with a horn tool, so that they lie closely to the board, and then brushed to remove any adhering dust, etc. After the skins have become dry, three or four coats of color are applied in succession, and the skins allowed to dry upon the boards. When dry they are taken from the boards, put in a damp place and worked with the stretcher. Lixiviated boards of linden wood joined with glue compounded with linseed oil are used for the purpose. After use they are thoroughly washed with water, or, if necessary, with weak lye or diluted acid. Every time before being used they must be painted with a decoction of flaxseed, this promoting partly the clinging of the skins to the boards and protecting them from dirt.

The colors used are as a rule the same as used for dyeing by dipping.

For *violet* apply a gray ground with dwarf elderberries and upon this a decoction of logwood. Chamois and nankin are obtained with Avignon berries and Brazil-wood; hazel-color by an addition of dwarf elderberries, and chestnut color by a further addition of logwood decoction. For olive-green apply first a mordant of acetate of iron or copper, and then a color prepared from Hungarian yellow berries with more or less logwood decoction, etc. For black a decoction is used prepared for 1 gross of skins, by boiling 2 pounds 3 ounces of Hungarian yel-

low berries, 2 pounds 3 ounces of sumach, 11 pounds of logwood in $4\frac{1}{2}$ to $5\frac{1}{2}$ gallons of water until reduced to one-half the quantity. After filtering apply the fluid to the skins, and when dry give a coat of liquor of acetate of iron of 2° B., and repeat the alternate application twice more. When the skins are thoroughly dry, wash them with a brush and water, and then work them with the stretcher. Should the color be wanting in intensity give another coat of logwood decoction only. After drying, a lustre is imparted to the skins by brushing them with a strong solution of white soap into which the yelks of a few eggs have been stirred. A good lustre is also obtained by using a mixture prepared for 6 dozen skins, by boiling $10\frac{1}{2}$ ozs. of soap, $1\frac{1}{4}$ ozs. of lard, and $1\frac{3}{4}$ ozs. of soda in a sufficient quantity of water, and adding a decoction of $10\frac{1}{2}$ ozs. of flaxseed. After polishing, the skins are rubbed with a woollen rag and worked once more with the stretcher.

The English method, which is now generally used, has the advantage of furnishing more durable colors than the other methods, though very delicate shades such as by dipping can only be produced with difficulty or not at all. The process consists in giving the skins first a ground with a potash solution and applying upon this the dye liquor. Firing required for some colors is effected by an application of green vitriol. The principal object of the alkaline ground is that by preventing the dye-liquors from penetrating, a greater saturation of the surface with dye is effected, which may possibly be due to the decomposition of the free alum still present in the skins. The mode of executing the process is as follows:—

After cleansing and moistening the skins in warm water until they show no white spots, the water is poured off without wringing the skins. Then take one yelk of egg for each skin, stir all the yelks together with some warm water, and after pouring the liquid over the skins, beat with the feet until all the egg substance has been absorbed. Then take each skin separately from the vat, and, after rinsing thoroughly in cold water, spread it upon a table so that it has no wrinkles. The table is somewhat higher on the end where the workman stands, and is provided with a zinc top and a ledge open on the lower edge where the

fluid runs off. The spreading out of the skin is effected with a tool of horn.

The alkaline mordant consisting for dark colors of a solution of 1 part of ordinary blue potash in 15 parts of water, and for light colors of 1 part of potash in 30 parts of water, is then applied with a brush. Instead of the potash solutions, solutions of 1 part of soda in 10 parts of water or 1 part of soda in 25 parts of water may be used. After applying the solution quickly and smoothing out the wrinkles, a second coat is given.

The thoroughly cooled dye is then immediately applied with a somewhat stiffer brush than is used for laying on the ground. The work should be done as quickly and uniformly as possible. Rubbing with a full brush upon one spot must be avoided.

After applying the color, the skin is washed upon the table with well water, and then smoothed to remove the wrinkles. Applying color and washing is repeated until the water runs off clean. For colors requiring firing, a solution of $\frac{9}{10}$ths to 1 oz. of Salzburg green vitriol and $4\frac{1}{4}$ to $5\frac{1}{4}$ pints of water is applied after the second coat of paint and washing. Paint the skin thoroughly and uniformly with the solution, and, after allowing it to soak in somewhat, proceed with the washing with well water and smoothing as before.

French Method.—In *France* a somewhat more alkaline mordant is used. It is generally composed of one quart of old urine which has become oily, $2\frac{1}{4}$ ozs. of sodium carbonate, and 2 small liqueur glasses full of liquid ammonia. By applying this mordant carefully a beautiful yellow color is obtained with fustic of prime quality. By adding a little red to this color, chamois is produced, and orange-yellow by increasing the proportion of the red color with an addition of some Avignon berries. Hazelnut and chestnut-brown are obtained by adding more red and some violet.

Before proceeding with the dyeing the skins are sorted according to the colors for which they are best adapted. The best quality is used for light brown, mixed brown, olive-brown, sap-green, and olive-green; the medium for lemon color, orange, violet, dark brown, dark gray, and nankin color; and the poorest for dark green, iron gray, and black.

With the exception of spirituous tinctures, which can be kept in well-stoppered bottles, it is best to mix the colors fresh and use them immediately after cooling. Scrupulous cleanliness and order should prevail everywhere. The cloth or sieve for straining the color, the vessels for the latter, the brushes, and especially the dye-table must be kept as clean as possible.

The mechanical portion of the dyeing of alum leather is divided, according to the French method, into five parts:—

1st. The assorting of the skins into the different colors and shades, and if for gloves into ladies' and gentlemen's.

2d. The washing, cleansing, that is to say, the preparation of the skins for dyeing.

3d. The dyeing itself (a) on the table; grain and flesh dyeing (b) by dipping the whole skin in the dye liquor; viz.: plonge, suede.

4th. The drying of the dyed skins.

5th. "Boarding" the same; that is, to render the dyed and dried skins soft and smooth again.

The first thing to do is to assort the skins into the different classes, as it is impossible to take alum skins and dye them just as they run.

Into the first class we put all the skins of a very fine grain, the smoothest and freest from air, lime, or iron spots. On these skins there can be dyed shades such as Havana, Bismarck, Dore, light chestnut, or leather brown, light terra-cotta, old gold, steel gray, mais, etc.

The second class embraces skins on the grain of which we can recognize the marks left from the black hair of the living animal. Such skins are reserved for light chocolate, brown, medium olive, smoke gray, Russian green, dark terra-cotta, carmelite, etc.

The third class consists of skins on which the alum or salt, while drying after tawing, has formed a kind of a marbled face; skins with a partially open or coarse grain. On these skins there is usually set a dark olive color or bronze, dark grays, bottle-green, or black; also the very dark brown; in general such shades in the composition of which an iron salt is used, such as sulphate of iron, as a striker.

The fourth class of skins are those the grain of which is too much damaged. These skins should be dyed on the flesh side (undressed kid), provided this part of the skin proves consistent enough in its structure to support the emery wheel or pumice-stone, in order to give it an even velvet-like face.

When the skins are thus selected, mark each class on the neck with a little cut; the first class with one cut, the second class with two cuts, etc., so that they can be recognized again should the whole lot be washed together in a drum or tub. The dyeing of alum leather is a very unthankful task. Even with the greatest care the skins often do not turn out as they ought to do. But one thing is certain, if we are not very careful, as in this case, our work is condemned beforehand, and we must not wonder if we spoil the skins or produce uneven dyeing.

We entered upon a full explanation of the assorting and preparing of the skins for dyeing, because it is, so to say, the principal operation of the dyeing itself; on badly-prepared skins, a dyer cannot set an even color.

Suppose the skins we assorted belong altogether to the first three classes, that is to say, they are skins to be dyed on the grain and in fancy colors. We marked the different classes with little cuts at the neck; now that they are washed, we have to assort them again. On class No. 1 we will set a leather-brown; class No. 2 we will dye in a medium olive; of class No. 3 we will dye one-half of the lot chocolate-brown, and the remaining skins bottle-green.

In the morning, while the brusher (that is, the man performing the mechanical work of dyeing the skins) is cleaning the dye table, bowls, dye brushes, and assorting the prepared skins into the different classes again, the head dyer is preparing and mixing the colors. For this purpose, he needs the so-called mother dye-liquors—red, yellow, and blue. If it is not advisable to prepare the dye liquors by boiling the dyewood chips ourselves, which preparation requires at least three hours' boiling, it may be equally as good to have the extract of such dyewoods on hand, in which case the boiling lasts only a quarter of an hour. Many dyers say they cannot depend on the extracts of

dyewoods. This was probably true before we had the improved machinery to produce good and pure dyewood extracts.

In preparing the three mother dye liquors, the dye stuffs used for this purpose are: For No. 1, extract Brazil-wood (*Cæsalpinia christa*); for No. 2, extract fustic (*Morus tinctoria*); for No. 3, extract logwood (*Hæmatoxylon campeachianum*).

To prepare the Brazil-wood mother dye liquor, put 20 gallons of clear water in a copper kettle, if boiled by open fire, or in a wooden tub or barrel if boiled by steam. To produce a strong dye liquor, 5 pounds extract Brazil-wood are allowed to boil for about 10 minutes. After this time add, always under stirring, one ounce of potash and one ounce of soda, in small quantities, and continue to boil it for 5 minutes longer. Now this mother dye liquor is ready, and must be drawn off in a separate barrel and covered.

The fustic mother dye liquor is prepared exactly in the same way, the same quantity of water, dye wood extracts and chemicals being used.

For the logwood mother dye liquor, use only 4½ pounds extract for 20 gallons of water. To this add 1 gallon old urine. After boiling 10 minutes, add 1 ounce soda and 2 ounces potash, and continue to boil for 5 minutes. Then the liquor is drawn off into a barrel and ready for use.

Clean the kettle or tub thoroughly after each color is boiled, so that one color will not interfere with the following one.

Besides these mother dye liquors, there are also required the so-called strikers. These are solutions of metallic salts, mostly sulphates. To dye our intended four shades we need three of them: striker No. 1, alum 3 pounds dissolved in 40 gallons of water; striker No. 2, sulphate of copper, 3 pounds, dissolved in 40 gallons of water; striker No. 3, sulphate of iron, 1 pound, dissolved in 40 gallons of water.

Now that the skins are ready for dyeing, the mother dye liquors and strikers prepared, we can proceed to compose our shades. The first is—

Light-Leather Brown.—Take fustic dye liquor 12 gallons, Brazil-wood dye liquor 1¼ gallons, logwood dye liquor 3 quarts. Use striker No. 1. The second shade is—

Olive.—Take fustic dye liquor, 6 gallons, logwood dye liquor 6 gallons, Brazil-wood dye liquor $\frac{1}{4}$ gallon. Use striker No. 2. The third shade is—

Mi-fonce Brown.—Take fustic dye liquor 4 gallons, Brazil-wood dye liquor 6 gallons, logwood dye liquor 4 gallons. Take striker No. 2 and striker No. 3 in equal proportions; mix well and use. The fourth and last shade is—

Bottle Green.—Take fustic dye liquor 4 gallons, logwood 8 gallons. Use striker No. 2.

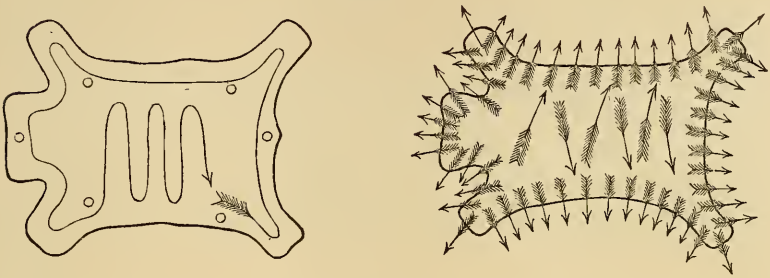
The dye is applied with a suitable brush. The hair of such a brush should be pretty stiff, and about $1\frac{1}{2}$ inches long, so that it may hold a proper quantity of dye liquor by dipping it in the bowl which is placed on the sideboard near the dye table. The wet skin is spread on the table which is shown in Fig. 300, flesh side down, and stretched out with a wooden or rubber "slicker." The skin must, of course, lie evenly on the table, so that no fold can be seen. Now apply consecutively two brushes full of old urine on the skin, brushing with each brush full of liquid two or three times around the skin. It is unnecessary to say that, for the urine (mordant), as well as for the dye liquors and strikers, an extra brush is used. Never change the brushes, nor use a dye liquor brush for striker, or *vice versa.* After the mordant is applied to the skin, put the color on it immediately. Each skin must be brushed four times at least, taking each time a good brush full of dye liquor (or two if necessary), brushing the skin on all its parts for about one and a half minutes with each brush full of dye liquor. In brushing the skin, while dyeing it, it is necessary to be quick, always trying to keep the dye liquor as much as possible on the surface of the skin. The weak part of the skin, as for instance the flanks and the neck, where the dye does not take very well, should be brushed a little more than the middle of the skin, that is, the back.

The method of brushing the dye liquor on the skins is indicated in Fig. 301.

A dyer should never commence to dye a lot of skins before being certain that everything is right. Consequently it is best to dye one of the prepared skins in the regular way with the

dye liquor prepared for the whole lot of skins; dry it and stretch it out, in order to see the shade and compare it with the sample, so that we may discover the error, if there is any, and correct it. Then, but then only, the brusher can continue to

Fig. 301.



dye the whole lot. The imitation on paper of these shades is not quite so nice as are the leather samples. On leather, of course, these shades appear fuller, that is to say, better nourished.

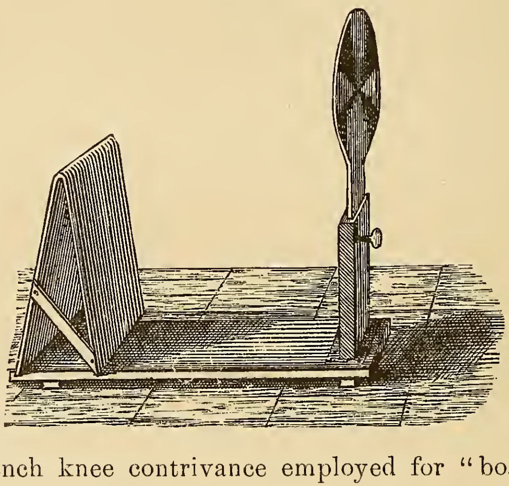
After the skin is well nourished with dye liquor, put the striker on it. This striker it is convenient to have also in a bowl on the table, so that it can be reached when required. Two brushes full of striker applied in the above-mentioned way are sufficient for each skin. Now the skin is dyed and ready to be rinsed with water out of a barrel kept near the table—that is to say, a dipper full of water is poured over it; then turn the skin flesh side downward and drive all the superfluous water out of it by means of a copper slicker. After this take the skin from the table and hang it up, clean the table with water and recommence the same manipulation with another skin. As soon as four skins are dyed, hang them up in the dry-room or in the open air, in the shade, as the wet skins must never be hung in the sun.

When the skins are dyed and dried they appear hard and stiff and require to be softened again. For this purpose lay them in damp pinewood sawdust, in pairs, with the grain inside, so that the sawdust touches only the flesh side of the skins. When they have absorbed sufficient dampness, take them out of the

sawdust and press them in a basket. Now they are ready to be "boarded," that is to say, softened again. If the skins which it is desired to soften are not damp enough, it will be hard work to soften them perfectly; if, on the contrary, they are too damp, there is the risk of cracking the grain while boarding them.

After the skins are softened they are, of course, too damp to bring into the market. It is necessary then to hang them up, in order to get rid of the dampness. When entirely dry overlet them on the board again—that is to say, pull them in the length and width, to get rid of any hardness remaining, occasioned by the last drying. After the manipulation of overletting, the skin must stay altogether in the width, not in the length, and it is in this shape that they are in condition to go into the market.

Fig. 302.



The French knee contrivance employed for "boarding" or softening, and overletting the skins is shown in Fig. 302; the armboard is shown in Fig. 243.

Section IV. Receipts for Various Vegetable Colors, and for Coloring Leather with Mineral Pigments.

We give in the following a number of receipts taken partly from *Prechtl's* "*Technological Encyclopedia*," a work which, though somewhat old, contains many valuable items.

Dark brown.—Boil 8 parts by weight of Hungarian fustic, 1 part of logwood, 2 parts of Brazil-wood, 1 part of sandal-wood, and ½ part of quercitron in sufficient water to cover the ingredients about 2 inches deep, for 1 hour. Strain the liquor through linen, and when cold use for dyeing after an application of green vitriol. By boiling the ingredients with water for a second time, the resulting decoction can be used for a similar color.

Light brown.—By applying a thin ground of potash solution and omitting the coat of green vitriol, the above color can also be used for this.

Olive-brown.—Boil as above 2 parts of Hungarian fustic, 1 part of quercitron, and ¼ part of logwood. Apply the color upon a strong ground of potash solution, and then give a coat of green vitriol.

Catechu brown.—Apply a decoction of 1 lb. 2 ozs. of catechu in 10½ gallons of water, and 2 ozs. of green vitriol to the slightly grounded skins.

Catechu gray-brown is obtained with the above color and an after application of solution of green vitriol.

Coffee brown.—Apply to the moist skin a ground composed of a solution of 2¼ lbs. of acetate of copper in 13¼ gallons of water, and after draining, wet immediately with a solution of yellow prussiate of potash in slightly acidulated water.

Dark green.—Apply a decoction of 4 parts of quercitron and 1 part of logwood upon a strong ground with an application of green vitriol. Some dogwood berries may be added to the decoction, and for fining a like quantity of blue vitriol to the green vitriol.

Olive green.—Decoction of 2 parts of quercitron, 1 part of Hungarian fustic, and some dogwood berries. Apply upon a strong ground. Omit the vitriol.

Light olive green.—Give the skins a light ground with Berlin blue, and apply upon this a liquor obtained by boiling 2¼ lbs. of fustic, and 10½ ozs. of archil in 5¼ gallons of water.

Picric green.—Apply a solution of picric acid in water to the skins previously grounded with Berlin blue.

Lemon color.—After digestion 1 part of turmeric in 4 parts of

ordinary spirit of wine at a moderate heat or in the sun for 24 hours, and diluting with ordinary whisky apply the mixture uniformly with a clean sponge kept especially for this purpose. After drying upon the boards rub the skins with a woollen rag dipped in Spanish chalk, without previous application of a coat of green vitriol.

Quercitron yellow is obtained in various shades by applications of decoctions of quercitron bark.

Barberry yellow.—Apply a liquor obtained by boiling $2\frac{1}{4}$ lbs. barberry root and 7 ozs. of alum in 8 gallons of water.

Rust yellow.—Apply a composition obtained by boiling $2\frac{1}{4}$ lbs. of annotto, 7 ozs. of soap, and 4 ozs. of potash in $10\frac{1}{2}$ gallons of water.

Orange.—Digest 1 part of Brazil-wood shavings in 8 parts of spirit of wine, and after diluting with whisky add more or less of the above lemon color. Apply the mixture to the slightly grounded skin, omitting the application of green vitriol. Orange is also obtained with annotto and decoction of madder.

Violet.—Digest 1 part of dry shavings of logwood in 8 parts of spirit of wine, and after diluting with whisky, treat the slightly grounded leather as above.

Mixed brown.—A beautiful brown of various shades is obtained by mixing different proportions of the three foregoing colors: lemon color, orange, and violet. Apply upon a slight ground without an application of green vitriol. A darker color is obtained by repeating the application.

Sap green.—Digest 1 part of buckthorn sap in 4 parts of spirit of wine, and apply upon a slight ground in the same manner as given for lemon color, omitting the application of green vitriol.

Nankin yellow.—Digest 1 part of madder in 4 of spirit of wine and apply in the same manner as lemon color, without application of green vitriol.

Dark blue.—Use a concentrated decoction of logwood upon a strong ground without application of green vitriol. A better and faster blue is obtained by applying a solution of indigo carmine.

Red.—A magnificent shade of red is obtained by an application of cochineal color prepared by tying the cochineal in a

small linen bag and boiling in water to which has been added about 2 per cent. of spirit of sal ammoniac.

Alazarine red (*a pale flesh color*) is produced by rubbing the cleansed and trodden skins with a solution of alazarine or extract of madder in weak soda lye and rinsing in water.

Scarlet is produced by an application of extract of carthamus, especially upon skins with a weak annotto ground. The extract of carthamus is dissolved in a solution of 1 part of tartaric acid in 60 parts of water.

Red of any other shade is obtained by applying spirituous extract of sandal-wood upon a weak ground.

Dark gray.—Decoction of 1 pound 2 ounces of Indian fustic, 9 ounces of tan-liquor and $\frac{1}{3}$ to $\frac{1}{2}$ ounce of concentrated decoction of logwood. Apply upon a strong ground and give a coat of green vitriol.

Iron gray.—9 ounces of tan-liquor, $2\frac{1}{4}$ pounds of solution of green vitriol, and $\frac{1}{8}$ to $\frac{1}{4}$ ounce of logwood extract. Apply upon a strong ground, omitting the application of green vitriol.

Black.—Boil 1 part of logwood and $\frac{1}{2}$ part of quercitron for two hours. Apply upon a strong ground and follow with an application of green vitriol. A black color is also obtained by boiling, for one dozen small skins, $2\frac{1}{4}$ pounds of logwood, 21 ounces of fustic, $\frac{1}{2}$ ounce of Hungarian yellow berries, $\frac{1}{2}$ ounce of pulverized gall-nuts and 1 ounce of sumach in 8 gallons of water for two hours, or until reduced to about one-half the quantity. Apply upon a strong ground and follow with an application of green vitriol.

A lustre is imparted to the leather by the process previously given.

Mineral Pigments.

Leather may also be colored by mineral pigments. The color is more durable and resists air and moisture better than that obtained with vegetable coloring matter, but the process is more troublesome on account of the difficulty of obtaining a uniform coloring.

The manner of execution is essentially the same as in calico printing. The skins, after cleansing and wringing out, are

placed upon the board, and the respective dye-solutions applied. Thus sky-blue is obtained by first applying a thick coat of solution of 9 pounds of yellow prussiate of potash in 16 gallons of water so that the skin is thoroughly permeated, and then a weak solution of acetate of iron, containing not more than $\frac{1}{4}$ to $\frac{1}{3}$ ounce of the salt to one quart of water.

Brown is obtained by using, instead of the iron solution, one of acetate of copper. Before applying the solution of yellow prussiate of potash it is made slightly alkaline by adding potash.

Chrome yellow is produced by applying a thick coat of a solution of one ounce of red calcium chromate in one pint of water, followed by an application of a solution of one ounce of sugar of lead in one pint of water.

Section V. Dyeing Chamois or Oil Leather.

The dyeing of this variety of leather differs from that of alumed leather in being executed almost exclusively by dipping, and the skins generally requiring to be treated with a mordant before applying the color.

The process is as follows: Skins to be dyed a light color are first exposed to the sun, and then uniformly moistened by treading in lukewarm water in the same manner as given for alumed leather. The skins are then placed and thoroughly worked in a warm mordant composed, for 20 skins, of a solution of $2\frac{1}{2}$ ounces of alum and $\frac{1}{4}$ ounce of tartar in about 20 times the quantity of water. After thorough soaking and slightly wringing out, the skins are immediately passed first through a weak dye-bath, and after wringing out, through a more concentrated one, the process being repeated until the desired shade is obtained. After thorough wringing out, the dyed skins, especially those intended for glove leather, are treated with a paste of alum and yelk of egg, shaken out, dried, and finally worked with the stretcher.

As oil or chamois leather is, as a rule, used for articles to be washed, it is of course self-evident, that only fast colors can be

used in dyeing. We will here briefly discuss the most important coloring matters used in this branch of the industry.

Madder red upon oil leather is obtained in the following manner: Dissolve, for every 10 to 12 skins, 2 pounds and 3 ounces of white sugar, and 13 pounds of alum free from iron in the required quantity of water, and add $4\frac{1}{4}$ pints of spirit of wine, and tread the skins in the solution for 2 hours. Before submitting the skins to the process, they should be thoroughly fulled with lukewarm water and washed with boiling water, and after passing through dilute sulphuric acid (1 part to 60 parts of water) subjected to a final washing. After working the skins thoroughly in the solution, remove them from the vat and after slight wringing, draining off, and rinsing in water, dry them in the shade. After partial drying replace them in the same bath, to which in the mean while some warm water and about one quart of spirit of wine have been added, and allow them to remain for one hour with occasional working. After the skins by repeated wringing out and replacing in the bath have been thoroughly soaked through, and passing them once more through the bath, spread them in piles upon a table for 2 to 3 hours.

The skins thus prepared now receive the actual mordant for madder red. This is prepared by mixing 20 pints of the above mordant with one pint of tin composition and 20 gallons of water. After stirring the mixture thoroughly, full or tread the prepared skins in it for one hour. After removing and allowing to drain off beat and roll them upon a smooth stone for some time, drawing them from time to time through the mordant. Then hang the skins up in the shade to dry, and when air-dried place them in a room heated to 86° F., where they should remain for at least 12 hours. The skins are then ready for dyeing. After taking them from the drying-room rinse them first in cold water, and after fulling in cold water, air and rinse them once more. To obtain a better color they are frequently trodden, before actual dyeing, in a bath composed of $1\frac{3}{4}$ to 2 ounces of madder and $26\frac{1}{2}$ gallons of water.

The madder bath is prepared by adding $8\frac{3}{4}$ pounds of good madder to 37 to 42 gallons of water in a boiler and heating gradually to a temperature not exceeding 118° to 122° F.

Place the skins in the bath one by one, and after allowing them to remain until the above temperature is reached, 5 to 6 hours being generally required, place them at once in running water, and after thorough rinsing and repeated fulling upon the stone hang them up to dry.

In order to give the dyed skins more lustre, they are placed in the fining bath prepared by mixing $26\frac{1}{2}$ gallons of water, $\frac{1}{2}$ pint of spirit of wine, and $\frac{1}{3}$ pint of olive or almond oil. After treading the skins thoroughly in this bath, rinse once more and dry. A solution of 2 pounds and 3 ounces of soap in $13\frac{1}{4}$ gallons of water may be used in place of the above fining bath.

Blue in all shades is obtained upon oil leather by dyeing in the indigo vat. The skins require no special mordant for this, but must, like for all other colors, be thoroughly trodden in water and moistened. Oil leather not thoroughly cleansed from free oil or fat, will not take the color uniformly, and must before dyeing in the vat be passed through a bath composed of 1 part of potash and 15 parts of water, and rinsed.

Green upon oil leather is obtained either by dyeing the skins, after giving them a ground in the blue vat, in decoction of quercitron, or, according to the old method, with buckthorn berries. The following receipt will answer for the latter purpose: Dissolve, for 12 dozen skins, 2 pounds and 3 ounces of green vitriol and 1 pound and 2 ounces of alum in $8\frac{1}{2}$ pints of water, and after adding 1 pint of this solution to the warm water required for treading the skins, work them thoroughly. After wringing, place them in a fresh bath of warm water somewhat colored with a decoction of $26\frac{1}{2}$ pounds of quercitron bark, $8\frac{3}{4}$ pounds of logwood, and 2 pounds and 3 ounces of Hungarian yellow berries. After treading them in this, replace them in the first vat, charged in the mean while with fresh water and some green vitriol. Tread them in this for some time, then replace them in the second vat, containing fresh water with a larger addition of the above decoction, and beat thoroughly with the feet. This process is repeated three or four times, adding every time an increased quantity of green vitriol and decoction. To the last dye bath add a decoction of ripe buckthorn berries, or the commercial sap green, increasing the quan-

tity, with vigorous stirring, until the desired shade of green is obtained. The skins are then allowed to drain off, and finally placed in a mordant, prepared by dissolving 6 ounces of acetate of copper in the required quantity of water. Rinse the skins thoroughly in the solution, and after rinsing in cold water dry them slightly in the air. To restore softness to the dyed skins, tread them in a mixture of 100 yelks of eggs, 1 pound and 2 ounces of alum, and the necessary quantity of water, and after wringing and drying work them with the stretcher.

Yellow.—This color if not produced with yellow ochre is obtained by means of a decoction of quercitron and previous mordanting with alum. Chrome yellow is seldom used. The latter color, which makes the leather weighty, can be best applied as has been described under mineral pigments. For this purpose the skins to be dyed are first thoroughly fulled in a bath of sugar of lead, and then thoroughly worked in a bath composed of 1 part of potassium chromate and 8 to 10 parts of water. They are next rinsed and dried.

Brown upon oil leather can be obtained by using the catechu bath mentioned for alumed leather. A beautiful red-brown is produced by dyeing the leather previously mordanted with acetate of copper, in a solution of yellow prussiate of potash and final rinsing in dilute acid. This brown is very fast and in many respects preferable to one produced by decoction of fungi, etc.

Black upon oil leather is conveniently produced in the following manner: After moistening the skins uniformly, apply to the side to be dyed a decoction prepared by boiling 10 parts of logwood, 10 of sumach, 2 of pulverized gall-nuts, and 2 of quercitron bark, in about 60 parts of water until reduced to one-half the quantity. Spread the moistened skins one over the other and apply the decoction to each one in succession with a soft brush. After all the skins have been brushed over give a second coat, commencing in the same manner, and finally a third one which will generally be sufficient. Next apply to the prepared skins two coats of black liquor, and when this is absorbed, a coat of the decoction, and upon this, if necessary, a third coat of black liquor. To obtain an intense black give a final

coat of pure decoction of logwood. To give lustre to the dyed skins, brush them lightly over, after drying, with olive oil in the same manner as alumed skins. To make the leather more salable it is recommended to black the uncolored side.

Section VI. Dyeing with Analine Colors and the Methods of their Preparation.

Having given in the foregoing sections of this chapter the most important methods of dyeing formerly in general use and still so in some places at the present time, it remains to give the process of dyeing with aniline colors.

Aniline colors, excepting the actual rosaniline colors, are especially suitable for coloring leather partly on account of their brilliancy of color frequently combined with a high degree of fastness, and partly on account of their being absorbed with avidity by the leather substance. A special mordant to prepare the leather for the reception of the coloring matter is but seldom required, a simple application of the color either in aqueous or spirituous solution being generally sufficient. Colors which can be used in aqueous solution are, as a rule, preferable to those only soluble in ethyl or methyl alcohol, especially as alumed leather will not stand strong alcoholic solutions. If colors only soluble in alcohol have to be used, care should be had to dilute the dilution with as much water as it will bear without separating the coloring matter. It is of course self-evident that the dyeing with aniline colors can be accomplished in the same manner as with other dye stuffs either by dipping or painting, though the latter method is with few exceptions to be preferred. If it should happen that the leather will not take an aniline color or does not dye uniformly, recourse must be had to a mordant. The most convenient and effective method of mordanting leather for aniline colors, is to apply a ground with a fluid containing tannin, it being of course necessary to use a composition which will not color the leather perceptibly. The best plan is to apply a solution of 1 part of tannin (pure gallotannic acid) in 20 to 25 parts of water with a sponge. After partly drying the leather apply the first coat of color, using a

weak solution, and stronger ones for the succeeding coats until the desired shade is obtained. For dark colors, such as orange yellow, brown, or even green, a cheaper solution containing tannic acid will answer the purpose just as well, a weak decoction of sumach being especially suitable. In using an aqueous solution of picric acid, which is also very good for giving a ground to leather to be dyed with aniline colors, the fact that the shade of the latter is frequently changed must be taken into consideration. A fast black can be produced with aniline colors, and in this and the next chapter we shall give the different modes in which it is accomplished.

Oil or chamois leather can also be dyed in the same manner as alumed leather with aniline colors, without requiring special preparation. Beautiful brown and blue colors can especially be produced with aniline colors, but for red it is better to use the process for madder red, as the color obtained with fuchsine or coralline, though very brilliant, is not particularly fast.

Aniline colors are especially valuable for dyeing parchment, since brilliant colors can be obtained without the parchment losing its transparency as is the case with other dye stuffs, especially such as require a mordant.

Aniline Violet.

Perkins's violet in a pure state is either a dark violet paste, or, what is more frequently the case, a dry green crystalline powder of a metallic lustre. It is but moderately soluble in cold water but readily in hot, and also, in the presence of an acid, in alcohol, wood spirit, glycerine, acetic acid, etc. From its solutions it is precipitated by alkalies and alkaline salts, and from spirituous solutions by water.

Parisian violet is insoluble in water, but dissolves readily by adding an acid.

Hofmann's violet, pre-eminent on account of its purity and beauty, is but moderately soluble in water but readily in alcohol, wood spirit, etc. In commerce, Hofmann's violet, of which there are two varieties, a reddish violet and a blue violet, occurs in bronze colored grains or crystals.

Rosaniline violet is a brownish blue powder with a weak lustre,

and is scarcely soluble in water but readily in alcohol and acetic acid.

Dahlia (dahlia impérial) is probably a by-product obtained in the manufacture of aniline red. It is a beautiful violet coloring matter of rare purity of color and is readily soluble in hot water. It differs from the ordinary aniline violet in assuming a brownish-red color when treated with concentrated sulphuric acid while the latter is colored blue.

Aniline Blue.

Bleu de Paris (soluble aniline blue) is a black-blue powder with a slight copper lustre. It is soluble in water, and may be precipitated from its aqueous solution with acids or common salt. This blue, on account of its solubility in water, may be especially recommended for coloring leather.

Bleu de Lyon.—This color does not differ chemically from the foregoing. It is difficult to dissolve in water, but readily in alcohol, and gives a beautiful blue color. It comes into commerce in lustrous masses of a copper-red color.

Ordinary aniline blue (also rosaniline blue) is insoluble in water, but soluble in alcohol, wood spirit, etc. It is also soluble in concentrated sulphuric acid, and can be precipitated in an unaltered state from such a solution prepared cold, by an addition of water. But by heating a solution in concentrated sulphuric acid to 266° to 284° F., even for a short time only, the blue precipitated by an addition of water and washed, is entirely soluble in boiling water. There are two principal shades of this aniline blue, *the bleu de lumière*, which shows a pure blue color by candlelight, and a darker blue, *bleu de Parme*, with a violet tinge and having a different color by candlelight.

Aniline Green.

Aldehyd green (rosaniline green) occurs in commerce either in the form of a paste or as a green powder. The article in paste form is the picrate of a base which has not been much examined. The paste is not soluble in water, but in alcohol and acids, while the powder dissolves in boiling water.

Ethyl rosaniline green dissolves with difficulty in water but readily in alcohol.

Emeraldine, a green patented in England by Calvert, Lowe, and Clift, is insoluble in water, alcohol, and acids, but dissolves with a blue color in concentrated sulphuric acid. It is constant in the light; but it is difficult to utilize it for coloring leather.

Aniline Yellow.

Ordinary aniline yellow is scarcely soluble in cold water but readily in alcohol, wood spirit, etc.

Zinaline is found in commerce in the form of a cinnabar-colored powder, which is insoluble in water but dissolves in warm solutions of borax, sodium phosphate, or sodium acetate. It is also soluble in alcohol and wood spirit, but is precipitated from these solutions by water. It gives reddish-yellow shades.

Chrysaniline is a yellow powder entirely insoluble in water, but soluble in alcohol, and gives a beautiful yellow color. Generally the hydrochlorate of chysaniline, found in commerce under the name of aurin, is used, it being tolerably soluble in water and yielding beautiful golden-yellow colors. Hydrochlorate of chrysaniline forms beautiful red-yellow needles.

Aniline Red.

The different red aniline colors known by the names of *fuchsine*, *roseine*, *azaleine*, *mauve*, *solferino*, *magenta*, *tyraline*, *rubine*, etc., are, no matter how different their mode of production, without exception the salts of a base termed by Hofmann "*rosaniline*." The product is brought into commerce either as red powder or, more frequently, as green granular crystals with a metallic lustre and sometimes several millimeters in diameter. The acetate, known in England and the United States by the name of fuchsine, forms especially beautiful crystals. In Germany the acetate is termed roseine and the hydrochlorate, fuchsine. Aniline red occurs but seldom in the form of a paste or in solution. In buying crystallized fuchsine great precaution should be exercised, as it is frequently adulterated, especially with sugar crystals. Pure fuchsine is sparingly soluble in water

of an ordinary temperature, but dissolves readily in hot water and very readily in alcohol, wood spirit, acetic acid, or in a solution of tartaric acid. It yields beautiful purple-red solutions which are discolored by an addition of alkalies or strong acids. The red color of solutions discolored by an addition by alkalies is, however, restored by adding acid, and that of those discolored by strong acids by an addition of water.

The nitrate of rosaniline, which is known by the name of azaleine, occurs but seldom in commerce, and is distinguished from the other varieties of aniline red by the pronounced cherry-red color of its solution.

The article known in commerce as *diamond magenta* or *fuchsine*, is produced in large crystals with a greenish lustre. It has the same properties as fuchsine, but has the advantage of being non-poisonous.

Tyraline is another aniline red with nearly the same properties as fuchsine.

Aniline Brown.

Havana brown is soluble in water, alcohol, and acetic acid. It is purified by precipitation from its solution with common salt.

Bismarck brown is a tarry, black-brown mass not soluble in water but in spirit of wine. The spirituous solution can, after mixing with water, be directly used for coloring brown.

Similar coloring matters known as aniline brown consist frequently only of by-products obtained by overheating the composition in preparing fuchsine. A special coloring matter discovered by Jacobsen, forms a black pulverulent mass insoluble in water, but soluble in spirit of wine, and gives quite a beautiful brown.

Aniline Black.

Aniline black is not an actual coloring matter, and does not occur as such in commerce, but is best produced directly upon the materials to be colored by the action of oxidizing agents upon the fabric prepared with an aniline salt (best aniline ace-

tate). The resulting color, which is actually a very dark aniline green, is by reason of the insolubility of the product of oxidation formed upon the fibre itself very fast, and resists more than any other black color the action of the most energetic acids and bases. To prepare this color numerous receipts have been given. Taking the nature of leather into consideration, which does not allow of the use of every oxidizing agent, the only one of the older receipts available for our purpose is Cordillot's, who uses ammonium ferrocyanide as an oxidizing agent. But the more recent process discovered by Persoz, Jr., might be still more available for leather. The best mode of applying Persoz's process to leather is to treat it, after moistening, with a solution of 75 grains of potassium bichromate, 45 grains of blue vitriol, and 30 grains of sulphuric acid in $2\frac{1}{8}$ pints of water. After thorough saturation wash the skins, and after passing them while still moist through a dilute solution of oxalate of aniline and rinsing them in a bath of tartaric acid, wash them again. They will acquire a beautiful black color immediately after passing through the aniline bath. Coloring by aniline black might also be readily produced by applying, after soaking the skins in a solution of sugar of lead, a coat of solution of potassium bichromate in water and, after washing the painted side which has now a yellow appearance, applying to it a coat of solution of oxalate of aniline in water to which some sulphuric acid has been added. By this process the black color appears also quite quickly and remains unchanged by the rinsing in water to which the skins must be finally submitted.

A product recently introduced in commerce under the name of "*Lucas aniline black*," offers no special advantages, as the semi-liquid black paste consists mainly of hydrochlorate of aniline and acetate of copper, and can be readily produced by anybody.

Aniline black is without doubt a very valuable coloring matter, and its introduction for coloring leather would be very desirable, a fact of which every tanner would be convinced if he would take the trouble of testing its availability by experiments.

In connection with aniline black we would mention the *aniline*

gray as one of the more important aniline colors. This coloring matter sometimes called murein, in many respects approaches aniline violet, is soluble in boiling water, and yields a pretty gray. Another gray produced by the action of aldehyde upon aniline violet in the presence of sulphuric acid is, on account of its present high price, not adapted for general use.

Besides the aniline colors which, with the exception of the actual rosaniline colors which are not fast, are now doubtless permanently introduced into the workshop of the dyer, partly on account of their ready application, and partly by reason of their brilliancy and freshness of color, there are other colors derived from coal tar which are equally valued. To this series belong first such as being direct products of the creasote in coal tar, are known as *phenol colors*. The most important are the *phenol red* or *coralline*, or *peonine*, *phenol blue* or *azuline*, and *phenol brown*.

Coralline,

a magnificent red coloring matter which several years before the analysis of Kolbé and Schmidt, was discovered by Persoz, and manufactured on a large scale in a Lyons factory, is a red powder scarcely soluble in water but readily in alcohol, yielding a scarlet solution. It is also soluble in alkalies, but the solutions change readily. It is not changed by acids. Coralline gives to alumed leather a beautiful orange-yellow color. To color with it dissolve it in alcohol and after adding some caustic soda mix the alkaline solution with water acidulated with sufficient acid to neutralize the soda. Unfortunately the fiery color which coralline yields does not stand exposure to light. Another variety of coralline (*coralline yellow*) differs from coralline red by giving a color with an orange tinge. The orange color obtained with it is very brilliant but will not stand exposure to the light.

Azuline.

This blue coloring matter, with a shade resembling ultramarine, is a coarse-grained powder with a slight copper lustre, and insoluble in water but soluble in alcohol. By heating it

with concentrated sulphuric acid for some time, it is, however, changed into a product of a like color soluble in water resembling in this respect aniline blue, which it is greatly like in appearance. Azuline may, like coralline, be dissolved in alcohol, and after diluting with water containing tartaric acid, be used for coloring leather.

Phenol Brown.

The discovery of this beautiful and fast coloring matter was made by Roth. It is found in commerce as a delicate brown powder sparingly soluble in water but readily so in alcohol, acetic acid, and alkalies, especially with an addition of some tartaric acid. Phenol brown is readily absorbed by leather, and imparts to it an agreeable brown color. By adding oxidizing substances, such as potassium chromate, to the solution of coloring matter, different shades from dark wood-brown to light brown are obtained.

Another series of colors belonging to this class are the so-called *naphthalene colors*. They are derived from a constituent of coal tar, naphthalene, a white crystalline body belonging to the hydrocarbons. Although many beautiful and valuable colors have been derived from naphthalene they have thus far not been so generally introduced as the aniline colors.

We shall, therefore, only mention the following as samples of this series: *naphthylamine violet*, *naphthylamine red*, *naphthyl blue* resembling alizarine, *naphtharazine*, and several yellow coloring matters, among which that prepared by Martius, deserves special consideration.

This magnificent yellow, known chemically as *dinitro-naphthalene*, forms small crystals of a brilliant yellow color and is scarcely soluble in water, but dissolves in alcohol and alkalies. It is also partly soluble in boiling water. It is not only one of the fastest colors, but furnishes also the finest shades, and is easily applied, as it is readily absorbed by the fibres. All the shades from the lightest lemon color to the darkest golden yellow can be produced with it without anything further being necessary than a corresponding concentration of the bath.

The above-mentioned colors are by no means all that have

been brought to our knowledge by recent researches, and we could fill page after page in enumerating them, but as many of those not mentioned have not been generally introduced into practice, and are not regular articles of commerce, we omit them here.

NOTE.—For portions of the matter contained in the foregoing sections of this chapter the author desires to acknowledge his indebtedness to Gintl's *Weissgerberei* und Beller's *Glacélederfärberi.*

SECTION VII. DYEING SUMACH-TANNED SKIVERS WITH ANILINE COLORS.[1]

We present herewith twelve samples of sumach-tanned skivers dyed with a few of the products of the Badische-aniline and Soda Fabrik at Ludwigshafen, Bavaria, and sold by W. Pickhardt & Kuttroff, New York, Boston, and Philadelphia. The skins shown in the samples are bleached by acetate of lead and sulphuric acid. The Nos. of the patterns correspond with those of the first twelve following receipts. For each color, the receipt for which is here given, the dye-bath is calculated for one dozen skivers, viz., 20 gallons of water.

No. I. *Methylene Blue O, Patented.*

Mordant.—Dissolve 8 ozs. white tartar in 6 gallons of water. Enter skivers; turn 6 times; lift on the horse.

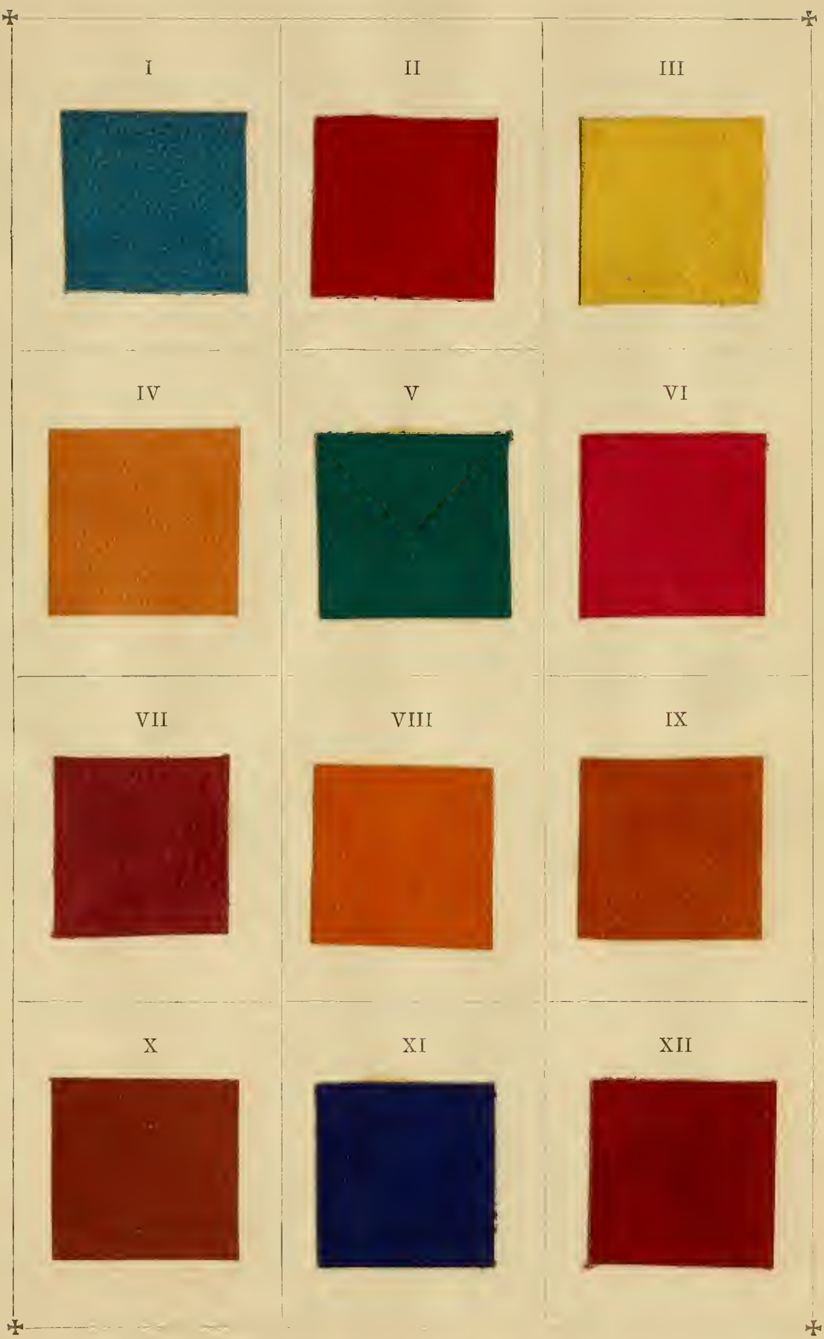
Now take:

1½ oz. methylene blue O, pat. { W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Boil in 2 quarts of water. When boiling, add 30 grains common salt.

Prepare dye-bath at 110° F. Add one-half of the prepared blue. Enter skivers; give 6 turns; lift, and add balance of prepared blue. Re-enter skivers, turn to shade, lift and rinse in plenty of water. Stretch on frames and dry.

[1] The author desires to acknowledge his indebtedness to the *Textile Colorist*, published at 506 Arch Street, Philadelphia, for the receipts comprised in this section.



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No. II. *Azobenzole Fast Crimson RR, Patented.*

Mordant.—Dissolve 1 oz. borax in 10 gallons of water.

Enter skivers; turn 6 times; lift on the horse.

Now take:

$1\frac{1}{2}$ oz. azobenzole fast crimson RR. pat.	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Boil in 2 quarts of water.

Prepare dye-bath at 110° F., and add one-half of the above prepared crimson. Enter skivers; give 6 turns; lift, and add balance of prepared crimson; re-enter skins; turn to shade; lift and rinse. Stretch on frames and dry.

No. III. *Naphthol Yellow L, Patented.*

Mordant.—Dissolve 1 oz. white tartar, 1 oz. tannic acid, in 10 gallons of water.

Enter skivers; turn 6 times. Lift on the horse.

Now take:

1 oz. naphthol yellow L, pat.	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Boil in 2 quarts of water.

Prepare dye-bath at 110° F. Add one-half of the dissolved yellow. Enter skivers; give 6 turns; lift, and add balance of dissolved yellow. Re-enter skivers; turn to shade; lift and rinse. Stretch on frames and dry.

This is a very fast color.

No. IV. *Leather Brown.*

Mordant.—Dissolve 3 ozs. white tartar, 4 ozs. alum.

Enter skivers; give 6 turns; lift on the horse.

Prepare foundation by boiling for 15 minutes 2 gallons of water with:

5 ozs. ext. fustic, 1 oz. ext. hypernic, $\frac{1}{2}$ oz. ext. logwood,	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Make a bath of 10 gallons altogether, at 110° F. Enter skivers; give 6 turns; lift on the horse.

Now take:

$1\frac{1}{4}$ oz. leather brown, { W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Dissolve in 2 quarts of boiling water.

Add one-half of the prepared brown to foundation bath. Enter skivers; give 6 turns; lift, add balance of prepared brown. Re-enter skivers, turn to shade; lift, rinse, stretch on frames, and dry.

No. V. *Victoria Green.*

Mordant.—Dissolve 3 ozs. white tartar, $\frac{1}{2}$ oz. tartaric acid in 10 gallons water.

Enter skivers; give 6 turns; lift on the horse.

Now take:

$1\frac{1}{2}$ oz. Victoria green, { W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Dissolve in 2 quarts of boiling water; add 1 oz. indigo paste; let boil five minutes.

Prepare dye-bath at 110° F. Add one-half of the prepared green. Enter skivers; give 6 turns; lift, and add balance of prepared green. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. VI. *Dark Rose Pink B.*

Mordant.—Dissolve 6 ozs. alum in 10 gallons of water.

Enter skivers; give 6 turns; lift on the horse.

Now take:

$\frac{3}{4}$ oz. rose pink B, { W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Dissolve in 2 quarts of boiling water.

Prepare dye-bath at 110° F. Add one-half of the prepared pink. Enter skivers; give 6 turns; lift, and add balance of prepared pink. Re-enter skivers; turn to shade, lift, rinse, stretch on frames, and dry.

No. VII. *Orceine B.*

Mordant.—Dissolve 1 oz. borax in 10 gallons of water.

Enter skivers; give 6 turns; lift on the horse.

Now take:

$1\frac{1}{2}$ oz. orceine B,	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Dissolve in 2 quarts of boiling water.

Prepare dye-bath at 110° F. Add one-half of the prepared orceine. Enter skivers; give 6 turns; lift. Pass back through mordant-bath; give 6 turns; lift, and add balance of prepared orceine to dye-bath. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. VIII. *Orange BR.*

Mordant.—Dissolve 2 ozs. tannic acid in 10 gallons of water.

Enter skivers; give 6 turns; lift on the horse.

Now take:

$\frac{3}{4}$ oz. orange BR,	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Dissolve in 2 quarts of boiling water.

Prepare dye-bath at 110° F. Add one-half of the prepared orange. Enter skivers; give 6 turns; lift, and add balance of dyestuff. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. IX. *Bismarck Brown R.*

Mordant.—Dissolve 3 ozs. tartar, $\frac{1}{2}$ oz. borax, in 10 gallons of water.

Enter skivers; give 6 turns; lift on the horse.

Prepare foundation by boiling for 15 minutes 2 gallons of water with:

4 ozs. ext. fustic, 1 oz. ext. hypernic, $\frac{1}{2}$ oz. ext. logwood,	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Make a bath of 10 gallons altogether, at 110° F. Enter skivers; give 6 turns; lift on the horse.

Now take:

1 oz. Bismarck Brown R,	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Dissolve in boiling water.

Add one-half of the prepared brown to foundation bath.

Enter skivers; give 6 turns; lift, and add balance of dyestuff. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. X. *Fast Brown.*

Mordant.—Dissolve 3 ozs. tartar, 4 ozs. alum, in 10 gallons of water.

Enter skivers; give 6 turns; lift on the horse.

Now take:

$1\frac{1}{2}$ oz. fast brown,	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Dissolve in 2 quarts of boiling water.

Prepare dye-bath at 110° F. Add one-half of the prepared brown. Enter skivers; give 10 turns; lift, and add balance of dyestuff. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. XI. *Soluble Blue R.*

Mordant.—Dissolve $1\frac{1}{2}$ oz. borax in 10 gallons of water.

Enter skivers; give 6 turns; lift on the horse.

Now take:

$1\frac{1}{2}$ oz. soluble blue R,	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Dissolve in 2 quarts of boiling water.

Prepare dye-bath at 110° F. Add one-half of the prepared blue. Enter skivers; give 6 turns; lift, and return to mordant-bath; give 6 turns; lift, and enter dye-bath, to which has been added dyestuff; turn to shade; lift, rinse, stretch on frames, and dry.

No. XII. *Fast Red R, Patented.*

Mordant.—Dissolve 1 oz. borax in 10 gallons of water.

Enter skivers; give 6 turns; lift on the horse.

Now take:

$1\frac{1}{4}$ oz. fast red R, pat.,	W. Pickhardt & Kuttroff, New York, Boston, and Philada.

Dissolve in 2 quarts of boiling water.

Prepare dye-bath at 110° F. Add one-half of the prepared

red. Enter skivers; give 6 turns; lift, and add balance of dye-stuff. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. XIII. *Brilliant Green.*

Mordant.—Add $1\frac{1}{2}$ ozs. sulphuric acid to 10 gallons of water.

Enter skivers; give 8 turns; lift on the horse.

Now take:

2 ozs. brilliant green crystals, } Kalle & Co., Biebrich-on-Rhine,
2 ozs. tartar, } New York and Philadelphia.

Dissolve in $\frac{1}{2}$ a gallon of boiling water.

Prepare dye-bath of 20 gallons of water at 120° F. Add one-half of the prepared brilliant green crystals. Enter skivers; give 6 turns; lift, and add balance of prepared green. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. XIV. *Russia Green.*

Manipulate the same as receipt No. XIII., after dyeing with brilliant green crystals. Then prepare a fresh bath of:

Nitrate of iron, 2° T., } E. Oakes & Co., New York and Philadelphia.

Enter skivers; give 6 turns; lift, rinse well, stretch on frames, and dry.

No. XV. *Rose Bengal.*

Mordant.—Dissolve 6 ozs. alum in 10 gallons water.

Enter skivers; give 6 turns; lift on the horse.

Now take:

$2\frac{1}{2}$ ozs. rose Bengal, AT, } Heller & Merz, New York.

Dissolve in 2 quarts of boiling water.

Prepare dye-bath at 110° F. Add one-half of the prepared rose Bengal. Enter skivers; give 6 turns; lift, and add balance of the prepared rose Bengal. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. XVI. *Scarlet, No.* 2.

Mordant.—Dissolve 8 ozs. alum in 10 gallons of water.

Enter skivers; give 6 turns; lift on the horse.

Now take:

3 ozs. scarlet, No. 2,	Kalle & Co., Biebrich-on-Rhine,
1 oz. white tartar,	New York and Philadelphia.

Dissolve in ½ a gallon of boiling water.

Prepare dye-bath at 110° F. Add one-half of the prepared scarlet, No. 2. Enter skivers; give 6 turns; lift, and add balance of prepared scarlet, No. 2. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. XVII. *Nankeen Brown.*

Mordant.—Add 1½ oz. tartar and ½ oz. tartaric acid to 10 gallons of water.

Enter skivers; give 8 turns; lift on the horse.

Now take:

1½ oz. nankeen brown,	I. Levinstein, Campbell & Co.,
1 oz. tartar,	New York.

Dissolve in one-half gallon of boiling water.

Prepare dye-bath at 120° F. Add one-half of the dissolved nankeen brown. Enter skivers; give 6 turns; lift, and add balance of the dissolved nankeen brown. Re-enter skivers; turn to shade; lift, rinse, stretch on frames, and dry.

No. XVIII. *Dark Nankeen Brown.*

Manipulate the same as for receipt No. XVII., except in dye-bath use:

3 ozs. nankeen brown,	I. Levinstein, Campbell & Co.,
2 ozs. tartar,	New York.

Section VIII. Dyeing Russia and Morocco Leathers with Aniline Colors.

In Jacobsen's *Chemisches Repertorium*, W. Eitner gives directions for the use of aniline colors produced by the Aniline Color Manufacturing Co., of Berlin.

The various shades obtained with it are pure and brilliant, being not only équal to, but surpassing those obtained with decoction of dye-wood.

Thus far we believe only three shades are manufactured. They are known as Russia leather red G light, Russia leather red G R medium, and Russia leather red R dark. But all three, even R, are light as compared with other products, but their tone of color is pure and fiery, instead of yellowish.

The coloring matter which is soluble in water is dissolved in boiling water in a clean boiler, the best proportion being 1 part by weight of coloring matter to 100 of water. Allow the solution to stand quietly for 2 to 3 hours to give any impurities a chance to settle.

For dyeing, mix more or less of the solution, according to the size of the skins to be dyed, with warm water. The first pair of skins is first brought into a very diluted dye-bath, then into a somewhat more concentrated one, and finally into the third, which is the most concentrated of all. The second pair of skins is brought into the second dye-bath used previously for the first pair, and then into the third bath previously used, and finally into a fresh dye-bath.

In this manner each pair of skins receives two dye-baths previously used, and one fresh one, the coloring matter being by these means thoroughly exhausted and a uniform coloring of the skins effected. After dyeing, the skins are rinsed by drawing them through pure water, and are then stretched, and slightly oiled during the latter operation.

If, in order to produce the odor of Russia leather, birch tar is added to the oil, it is neutralized with soda in case of acid reaction.

For the production of yellow and yellowish-brown shades, phosphin-orange—composed chiefly of hydrochlorate of chrysaniline and chrysotoluidine—is the most suitable of all tar colors. Boil 1 part of coloring matter in 500 parts of water until a perfectly clear solution is obtained which serves directly for the dye-bath. The color is very fiery and constant, and loses nothing in drying. For many purposes the fiery color of the dyed skins is dulled in a bath of potassium bichromate. For

dyeing leather golden orange, dissolve 1 part of "Philadelphia yellow," manufactured by the above concern, in 200 parts of water, and dilute the solution sufficiently for dyeing, or dissolve 1 part in 300 parts of water, which will give a dye-bath of proper concentration. This color, as well as the one previously described, does not spot unsound places in the grain, and is constant, pure, and fiery. The reddish shade of this group of colors is produced in precisely the same manner with Berlin blue G, and is not inferior as regards purity, constancy, and brilliancy to the above color. The three colors mentioned are specially suitable for brightening dark dye-wood colors by placing the leather dyed with Brazil-wood and black in a weak bath of one of these colors, the choice depending on the more reddish or yellowish shade desired. Besides the yellowish-brown shades, a pure orange, produced with corallin, is also much liked. The proportion is 1 part of coloring matter dissolved in 150 parts of water. But as corallin upon leather has a tendency to fade, the leather must be quickly handled and dried after dyeing. A half-dark pale blue, the so-called marine blue, is produced by dissolving 1 part of marine blue in 300 parts of water. Before dyeing the leather is *not* drawn through a bath of very dilute sulphuric acid, as is the case in dyeing with other aniline blue colors. For pale blue with a pure blue shade, the water blue B B is used, and for pale blue with a reddish shade the water blue B. Dark blue, which was generally produced in the indigo vat and after dyeing with a red coloring matter, is obtained by coloring the leather first with blue R or marine blue, and finishing dyeing in a second bath prepared by boiling nigrosin in 300 parts of water. The previous dyeing with blue is necessary since nigrosin applied directly to the leather colors badly and not uniformly. A beautiful bright green is obtained with methyl-green in crystals which is readily soluble in water. Its comparatively low price makes its use available for dyeing inferior qualities of leather, or at least for brightening leather dyed green in the ordinary manner with indigo and fustic. The green leather produced in the vat, or as is more frequently the case with sulphate of indigo, is washed in cold water in order to remove the acid which would alter the methyl-green, and

receives then a weak bath of methyl-green which will considerably brighten the originally dull and impure color. For producing violet color methyl-violets are the best, as they cover excellently, so that the most impure skins can be used for these colors. By a proper use of aniline colors, all the inconveniences of producing the light shades from yellow to orange so much liked at present, with dye-wood colors, are removed, and besides much more beautiful tones of color are obtained. The so-called *Martin's yellow* (*binitronaphthol as calcium* or *sodium salt*) is best adapted of all tar colors for the production of pure yellow tones of color. It is an orange-red powder which dissolves completely in hot water to a pure yellow fluid, and is one of the most constant and durable colors. Dissolve 1 part of Martin's yellow in 100 parts of boiling water in an earthen or wooden vessel (all contact with metal must be strictly avoided), accelerating the solution by stirring with a wooden spatula. After cooling, the solution is ready for use. For the production of orange tones of the reddest shade, such as are in demand for harness leather, a solution of 1 part of aurantia (the ammoniacal salt of hexanitrodiphenylanine) in 120 parts of boiling water is used. *Phosphin-orange* is also suitable for reddish-orange shades. Dissolve 1 part of the coloring matter by boiling in 40 parts of water, and after allowing the solution to stand quietly one day pour off the supernatant clear fluid from the sediment. For use, dilute the solution with 50 parts of water. The intermediate shades from pure yellow to the reddest orange are produced by mixing a solution of *Martin's yellow* with that of *aurantia*, the desired shade being determined by experiments. This operation is much facilitated by noting down the different proportions and adding to the notes a piece of leather dyed with the respective mixtures. All the coloring matters mentioned dye directly, requiring no grounding or mordant, and are fast and do not rub off. The dyeing is accomplished by spreading the dry leather upon a large table and applying the cold color uniformly with a long-bristled brush, the latter operation requiring, of course, some skill and care. It is very difficult to color the entire skin uniformly and without streaks by one application. It is, therefore, best to dilute the solutions of color given above with an

equal part of water and to apply two coats, the second being given after the first is dry. Two coats will be sufficient in all cases. Harness leather receives generally a more or less intense lustre, this being accomplished by rubbing with flannel, or by glazing with or without the assistance of wax, cerine, or stearine. To give leather straps at the same time color and lustre, a single application of *orange fat color* prepared at the above factory is sufficient, 1 part (for very sad color 2 parts) of coloring matter is dissolved in 100 parts of boiling water to which 1 part of soda has been previously added. Apply the lukewarm solution, which gelatinizes on cooling, to the leather with a brush or sponge. By rubbing the dry leather gently with flannel, the desired lustre is produced.

CHAPTER XLIV.

COMPOUNDS FOR COLORING AND POLISHING LEATHER.

A Black consisting of an Ammoniacal Solution of Shellac, and the Aniline Color known as "Pourrier's D Blue Aniline."

THIS composition, patented by Martyn, is composed of water, shellac, spirits of ammonia, and the aniline color, known as "Pourrier's D blue aniline," and which, when used in with the ammoniacal solution of shellac in proper quantity, produces a black.

To make the composition, take, for 24 ounces of shellac and 6 gallons of water, 1 pound of spirits of ammonia and 8 ounces of the aniline color, and thoroughly mix or stir the whole together, the water being heated to about 212° F. Use boiling water plentifully with the shellac, the spirits of ammonia, and the aniline color in order to combine the ingredients quickly and to advantage.

Protochloride of Iron in Solution as a Basis for Black for Skins.

This method, patented by Brainerd, may be used for coloring either partly tanned or fully tanned skins. The iron liquor is prepared by dissolving metallic iron in pure hydrochloric acid of the shops, at a temperature of about 80° F., until all effervesence ceases, leaving metallic iron in excess.

Of this saturated solution of iron take a fluidounce, and dilute it with pure soft water, and if the skins are only partly tanned, immerse them therein for a period of four or five minutes, keeping them in constant motion. The dilute iron liquor may be applied to the grain of the fully tanned skins with a brush.

From the iron liquor bath, immediately transfer the skins to a bath of clean water, and thoroughly wash, in order to free them from any hydrochloric acid that may have been formed by the decomposition of the protochloride of iron, by this latter element entering into a new combination with the tannin.

If preferred, the skins may be subjected to the action of a bath made slightly alkaline with ammonia, in order to neutralize any free acid formed.

The strength of the iron liquor, as above given, will be sufficient to make a jet black, but a day or two of exposure to the air may be necessary to produce the finest tone. A weaker iron liquor will give a correspondingly lighter shade of color. Skins that have been thoroughly tanned, may, by immersion in this iron liquor, be colored through their entire thickness. If it is desirable to color only the surface of the skin, it should be set out upon the table, while wet, and the iron liquor applied with a brush.

Preparing Raw Hides and imparting Black, Maroon, and Purple Colors.

The object of this process, patented by Merrill and Hoitt, is to prepare and color raw hides in such a manner that they will be permeated by the materials used, and thus rendered more durable and neat in appearance for the various purposes to which prepared hide is applicable in the arts, such as for tips and shields for boots and shoes.

The hides are unhaired, fleshed, and rinsed in the usual manner, and being removed from the rinsing-vat are prepared for coloring by being passed through lukewarm logwood liquor, made by placing a third of a bushel of logwood, in chips or coarse powder, in a bag, in which it is boiled in about twelve gallons of water until the strength is extracted. A sufficient quantity of the liquor is made for use, as wanted. The hides are laid flat, one above the other, in a vat containing sufficient logwood liquor to cover them, the temperature of the liquor being preferably lukewarm. This liquor may, however, be colder than lukewarm, and in such cases the hides must remain longer in it. The hides are kept in this liquor for two or three days, and are frequently turned until the strength of the logwood is extracted and the hides saturated.

The hides having been treated as described, are then blacked in a dyeing liquor made from the solutions here designated for convenience of description as Nos. 1 and 2.

No. 1 is made by boiling together for five or ten minutes four ounces each of pulverized nut-galls and blue vitriol in a gallon of hot logwood liquor, and afterward adding four quarts of vinegar saturated with iron in any well-known way, or the chemical equivalent of the vinegar and iron may be used.

Solution No. 2 is an iron-set, made by dissolving iron chips in aqua fortis or other acids, the iron being added until a saturated solution is obtained.

For the purpose of blacking about half a dozen hides, or two or three dozen medium-sized skins, place the hides, previously soaked in logwood-liquor, in about twenty-four gallons of logwood-liquor such as first described, to which have been added two quarts of the solution No. 1 and one pint of No. 2 solution, the latter having a tendency to set the color. The hides should be allowed to remain in this dye-liquor from one to three days, according to their thickness, being frequently turned to secure a thorough penetration.

The exact quantities above given are not arbitrary, as the ingredients vary in strength, and some hides will take color more easily than others. The quantities mentioned will generally be sufficient to thoroughly black two dozen calf-skins or a half

dozen kips or light cow-hides; but the heavier hides require to remain longer in the compound.

The dyeing-liquor requires to be replenished as its strength is exhausted, by the addition of fresh material, to keep it in substantially the proportions described. Maroon and purple colors may be made by working in the logwood-liquor and finishing by using aqua fortis and tin, with solution of logwood, instead of the dyeing-liquor.

Rawhide, after being subjected to this treatment, in which it is only partially tanned, is rendered a deep and permanent color throughout its entire surface, and is susceptible of a high polish, giving it a finished appearance similar to that of hard black rubber. It can be prepared at exceedingly low cost, does not become discolored by use, but retains its original neat appearance until worn out, and is thus of great value in the manufacture of tips or shields for the toes of boots and shoes, and of similar or other articles liable to rough usage.

Logwood has been described as the base from which the solution is obtained. It is selected because it is the cheapest and most readily obtained; but it is evident that more expensive materials—as nut-galls and other equivalent dyes from wood or vegetables—may be used instead of logwood.

In the preparation of No. 1 solution we have described that the blue vitriol and nut-galls were placed in hot logwood-liquor. This is preferable, but instead of logwood-liquor hot water can be used, increasing the quantity of nut-galls.

An Intense Black, etc., prepared from Aniline Colors, mixed with Alcohol, etc.

This compound, patented by Humphrey, is made of aniline-red, aniline-blue, and aniline-brown, mixed with alcohol, sulphate of iron, or muriated tincture of iron, water, oil, and amber, which, when applied to leather, or other suitable material, imparts an intense and durable black color.

In preparing: Take aniline color one and one-half parts; alcohol, one hundred and twelve parts; sulphate of iron, or muriated tincture of iron, sixteen parts; oil, eight parts; oil of

amber and water to suit, usually about two parts of the former and eight parts of the latter.

The aniline colors which the inventor employs, by preference, are red aniline, blue aniline, and brown aniline, and he generally takes equal quantities of these colors.

The aniline color is dissolved in the alcohol, and, by the addition of oil and sulphate of iron, a compound is obtained which will readily combine with the fibres of leather, the oil serving to penetrate the material, and to open its fibres, while the sulphate of iron, or muriated tincture of iron, acts as a mordant, whereby the color is firmly bound to the fibres.

In order to reduce the expense of this compound add to it a quantity of water, and the inventor also adds amber, for the purpose of disguising the smell of the alcohol.

The color produced on leather is a jet-black; but, by changing the proportions of the aniline colors, different shades may be produced.

Black Staining Compound for concealing defects in Leather and for applying to Pocket-books, composed of Aniline Colors, Naphthaline, etc.

The object of this process, patented by Wolff, is to produce a liquid compound which, being applied to the surface of leather, will impart a deep, indelible, black color.

To prepare the compound: Take 0.94 part of blue aniline, 0.26 part of yellow aniline, 0.48 part of naphthaline, and 0.32 part of red aniline, which are dissolved in 74 parts of alcohol in a suitable vessel by agitation. After being dissolved the liquid resulting is passed through a filter.

It is applied to the leather with a brush, and dries rapidly, and, when dry, presents a bronzed appearance, which will be converted into a deep black by the application of water with a cloth or sponge.

This staining material can be used in connection with other organic substances than leather; but it is chiefly intended to be employed on the latter for the concealment of defective places in the blackened surface.

After application, the leather may be dressed with liquid

blacking or paste, or such materials as are commonly used; in this event dispense with applying water, which is superfluous, as the bronzed appearance will be displaced upon the application of such dressing.

Its effects will be the same on every description of leather; but in classes of leather having a very close grain, such as pebble goods and those qualities used in the manufacture of pocket-books, etc., two coats of the compound should be applied the one upon the other, in order to obtain the desired intense black.

The yellow and blue anilines, by their union, form a green, which, by the addition of the naphthaline, is converted into a very deep green, so that, by the addition of red, it will produce a black. Of itself the mixture of the yellow and blue anilines would produce a light green of insufficient depth when mixed with the red to produce a deep black.

Another compound patented by Wolff consists of the same aniline colors as above, but is dissolved only in alcohol and is intended to form a base for a black coloring composition for leather.

To prepare this compound: take 0.87 part of blue aniline, 0.84 of yellow aniline, and 0.29 part of red aniline, and dissolve them in 74 parts of alcohol, preferably methylic alcohol, the composition, after the complete dissolving of the several ingredients, being passed through any appropriate filtering medium.

The result of this combination is a very dense coloring composition possessing great power of penetration.

The proportions given may be varied to some extent to accord with variations in the strength or density of the aniline colors employed.

The compound may be used as a black-varnish ingredient by dissolving in it shellac.

The composition may be used as a base for admixture with other materials in order to produce compounds for different purposes, such as coloring leather, compound for renovating harness, shoe-blacking, etc.

Compound for imparting a lustrous Black-Gloss to Leather.

Quinland has patented the following leather dressing compound for boots and shoes, carriage-tops, harness, trunks, satchels, etc., designed to impart to the same a lustrous black gloss, as well as to preserve and protect the leather.

It consists of alcohol, shellac, castor oil, ivory-black, and turpentine, in or about the proportions named.

In preparing: Take one gallon of alcohol, and dissolve in it two and a half pounds of orange-shellac. To this add one pint of castor oil, one-half pound of ivory-black, and one gill of turpentine.

In adding the ivory-black it is thoroughly incorporated and imparts to the liquid a dirty-black color, which, however, when applied to the leather surface, becomes, by reason of the evaporation of the alcohol and turpentine, a rich, lustrous black gloss.

Dyeing Leather, containing Tannic or Gallic Acid, Black, by subjecting it to the action of a Vanadic Compound.

This process, patented by Söerensen, relates to a method of dyeing leather black by means that are claimed to be more convenient, cleanly, and effectual than when the ordinary methods are employed.

The leather to which this manner of dyeing applies is such as has been tanned, and contains tannic acid, or gallic acid, or any of those derivations or combinations of or with which such analogous acids as turn black when acted on by compounds of vernadium. The dyeing can be effected at any time after the leather has been tanned. The action of the vanadic compound or preparation—which is employed in solution—on the surface or body of the leather treated is to turn it black.

It will be well understood that in order not to in any way injuriously affect the quality of the leather it will be most advantageous to employ a neutral vanadic solution, and the inventor claims to have successfully used a neutral solution of vanadiate of ammonia containing one per cent. of the latter salt. In order

to bring out a full black color the moderate use of heat is beneficial.

Blackening leather by vanadium preparations is claimed to be especially advantageous in the treatment of manufactured articles, such as boots and shoes, as the risk of damaging the upper portions of the same is avoided, and in the case of ornamental stitching in saddleryware the leather is rendered black, while the stitching retains its proper color. It also allows the operation to be performed without soiling the hands.

Gilding and Ornamenting Leather for Suspender Ends, etc.

The method patented by Walker consists in gilding or bronzing leather used for suspenders' ends with gold leaf, metal foil, or with bronze, either in the form of leaf or in powder. The gilt or foil or leaf is applied by means of stamps or dies containing any suitable ornamental design, and may be applied by any of the means now used, for imparting ornamental designs to leather by means of gilding and bronzing. The processes, being well understood by the workers in this method of ornamenting leather, need not be particularly described.

If the leather is dyed, it should be with fast colors, so that no stain will be imparted to the clothing. When artificial leather is used, it can be treated in the same way as real leather.

Gilding Leather.

The *Papierzeitung* gives the following method described for gilding leather. It is first moistened with a sponge, then stretched and tacked on a board. When dry it receives a coat of thick isinglass solution, then one of white of egg that has been beaten and allowed to settle. Upon this are laid lightly with a brush sheets of *silver foil*, which are then pressed down with a wad of cotton-wool. When this is dry it is painted over with yellow leather varnish, which gives it a beautiful golden appearance.

Bronze Dressing for Leather.

The object of this method, patented by Fennessy, is to provide a cheap and brilliant bronze dressing for leather, to be used

particularly for bronzing boots and shoes; and consists in a preparation composed of aniline red, blue, violet, or purple, or a mixture of two or more of these colors, dissolved in a suitable acid, and brought to the desired consistency by the addition of an acid solution of gelatine or a gum soluble in water.

To prepare: Take six ounces of aniline red and two ounces of aniline blue, violet, or purple, dissolve them in one quart of acetic acid, heating the mixture slightly in order to accelerate the operation, after which it is allowed to become cool. Then dissolve in a separate vessel thirty-two ounces of gelatine in one gallon of acetic acid, and add this mixture to that first described, after it has become cool, to give the required consistency to the compound. The whole is then thoroughly stirred together, when it is ready for use.

Any suitable acid other than acetic acid may be used; and in lieu of gelatine, a gum soluble in water—for instance, gum arabic, or gum tragacanth—may be employed, if desired. The proportions of aniline color or acid above stated may be varied somewhat according to the shade of bronze required; and any one of the aniline colors above referred to may be used singly instead of a mixture of these colors; but the inventor prefers the mixture first described, as it produces a more desirable shade of bronze. The quantity of gelatine or gum used may also be varied, according to the consistency required.

The dressing is applied with a soft brush, and gives a brilliant bronze finish to the leather.

Aniline Bronze Colors of Various Shades applicable to Leather.

This method, which is that of Fiorillo, consists, broadly, in the admixture of benzoic acid with aniline colors, for the purpose of producing a bronze paint or color, the shade or tint of which may be varied according to the aniline colors used and the detailed treatment to which they are subjected during the process.

To compound this bronze proceed as follows: Dissolve ten parts of aniline red, or so-called diamond fuchsine or roseine, and five parts of aniline purple (known in commerce as "Hofman's violet" or methyl violet) in one hundred parts of alcohol

of 95° strength, placing the vessel containing the mixture in a hot-water or sand bath, to promote the dissolution. As soon as the aniline has been dissolved in the alcohol add five parts benzoic acid, boil gently, then add thirty-two parts of gum benzoin, and continue boiling from five to ten minutes, until the cantharide-green color of the mixture disappears, changing into a bright golden bronze color.

The color thus produced is of a very high lustre, of great durability, and will adhere firmly to leather, and, in fact, to nearly all substances. It is readily applied with a brush, and dries in a few minutes. It will answer equally well on white and colored grounds; and may be used, on account of its durability and the facility with which it is applied, upon ladies' boots, slippers, shoes, or other articles of leather, to which it imparts a bright golden bronze hue.

Producing upon Leather Various Shades of light brown, and darker colors, by the combination of Oxalic Acid, Salt of Tin, and Potash, with Nut-gall and Sulphate of Iron.

The process patented by Jäger consists in washing the leather with the solution of salt of tin and oxalic acid to prepare it for receiving the color. Potash, nut-gall, and sulphate of iron are the ingredients of the compound for coloring.

The proportion of ingredients composing the wash for preparing the leather is one part of oxalic acid to three parts of water. With this solution the inventor washes all kinds of grain leather. With the solution of one part of salt of tin and three parts of water he washes all split leather and leather without grain. After the leather is perfectly dry it is ready to receive the color. The compound used to give the leather the various shades of light brown is composed of one part of potash and three parts of water. To get the various shades desired increase or decrease the strength of the solution. It is applied with an ordinary brush. For dark colors use the following compound: one part of sulphate of iron, one part of nut-gall, and three parts of water. This is also applied to the leather as stated. For the purpose of shading the color on the leather a solution of oxalic acid is prepared and slightly applied with a

sponge till the shades suit the operator. After the paint is well dried a mixture of starch and the white of egg is used for coating the leather. After the coating has well dried the leather is ready to receive the varnish.

Coloring Leather with Aniline upon a Starched Surface and producing an appearance similar to Marbled Paper.

This process, which is that of Koppitz and Mayer, is carried out by mixing the ground color with starch; as, for instance, if logwood is used as a ground color, the inventors boil it in vinegar until the color is sufficiently extracted, and after having stained the solution there is mixed with it a quantity of starch, generally one pound of starch to one quart of the solution, although the proportions are to be varied according to circumstances. For further coloring the leather the inventors use various aniline pigments, each of which is prepared as follows: First dissolve the color in alcohol, using for each ounce of the aniline pigment about one pint of alcohol. To this add about three quarts of vinegar, and next boil the solution for a few minutes, after which it is ready for use.

Next, the preparation of ground color is sprinkled on the leather or the latter is covered with the preparation to the necessary extent, after which the other color or colors or preparation of aniline, as above explained, is to be sprinkled or thrown upon the leather to the extent required. The starch of the first preparation will cause it to resist the aniline color or colors, or second preparation, whereby there will result a softening or shading together of the spots of ground and other colors at their edges in contact. This softening or blending of the masses or spots of colors at their edges with the ground colors produces a very pleasing effect, and although the leather has an appearance much like that of marbled paper, used in book-binding, no bath is required to produce the effect, as in the process of marbling paper. Furthermore, the preparation of the aniline color, by the employment of alcohol and vinegar, in manner as described, renders the color stable, or not easily oxidizable by light, the preparation being peculiarly fitted for coloring leather

with one plain color without first employing a ground color prepared with starch, as set forth.

We would observe that, generally speaking, whenever the ground color prepared with starch, as explained, becomes covered with the aniline color, the latter becomes readily removable by water, so that, after a skin may have been sprinkled with the ground and aniline dyes or colors, and is afterward washed, the aniline colors will remain fast in such portions of the skin not covered by the ground or starch color, but will be mostly if not entirely removed from the parts on which the starch color or ground may have been thrown. By this process it is possible to color leather or other substances for use in the arts with great economy, and with excellent practical and ornamental results.

Forming a Solution for Staining Tawed Leather, consisting in mixing Clay, Water, Common Salt, Sulphuric Acid, Brewer's Yeast, Alum, Hemlock Extract, and Terra-Japonica.

This process, patented by Richter, is carried out as follows: Prepare a clay mixture by filling a barrel or other vessel half-full of clay (preferably clay suitable for making bricks). Then add water sufficient to thoroughly reduce the clay, destroying its adhesive qualities and forming a mixture of thick or semi-liquid condition. Then mix therewith the following ingredients, in substantially the following proportions, viz: To every thirty-two gallons of the clay and water mixture add four quarts of common salt, one pint of sulphuric acid, and presently add one quart of brewer's yeast, and thoroughly incorporate them. An effervescence will ensue and continue for about twenty-four hours, and when it ceases the liquid compound will begin to precipitate. Then remove the impurities deposited and leave the supernatant water, and fill the barrel or other vessel with water and dissolve therein six ounces of alum to every thirty-two gallons of liquid. Then add to this mixture one pound of hemlock extract and one pound of terra-japonica thoroughly dissolved in hot water. Apply to the hides, after being tawed and dressed, by pouring the mixture over them when in a close

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vessel, so as to cover them, and keep about thirty-four hours in solution.

Preparing, coloring, and polishing Light Skins for Car Seats, Trunk Covers, etc.

This process, patented by Dyar, relates to the preparation of leather for the purpose of imparting a finished or ornamented surface to the same, having particular reference to converting cheap or light skins into material for car seats and linings, boot and shoe linings, trunk covers, etc., where light stock may be used to advantage, if it has a finished and uniform surface.

In accomplishing this object the surface of the skin to be prepared is first filled with a composition (using a compound which can be polished by friction), and the dead or lustreless surface of the leather left by application of the composition is next printed (by any one of the ordinary printing processes) with any suitable design or figures, and in any desired colors. The surface is then solidified and polished by working a tool over the skin, laid upon a bed, as in ordinary levelling, solidifying, or polishing machines. The skin to be prepared is preferably in a dry condition when treated, and the composition the inventor prefers to use is made up of a mucilage or pulp obtained by soaking flaxseed in water, and straining off the pulp, and dissolving in the pulp, freed from the seed, white soap, adding also a little linseed or other oil. This composition is thoroughly worked into the surface of the leather, and the leather subsequently dried. Then the pattern or design is laid or printed on the prepared surface, after which the leather is subjected to the action of the polishing tool, the mucilaginous and saponaceous surface so combining with the imprinted colors that a uniformly polished and hardened surface is imparted to the whole skin, the tool gliding over the printed characters without moving or spreading them. Deer, neat, goat, calf, and sheep-skins may all be prepared in this manner, and upon either the grain or flesh side, as circumstances may make desirable.

Composition of Glycerine, Resinous and other Substances affording a Base for imparting a High Polish to Leather.

The composition patented by Farnham, is intended for application to leather-work, for the purpose of rendering the leather impervious to water, and at the same time affording a base which is susceptible of receiving a high polish, preserving, also, the flexibility of the leather.

The employment of resinous substances as a coating for leather has been objectionable, because such resinous substances, on becoming dry, would crack, and cause the leather to break. It is claimed, that by mixing glycerine with a resinous compound, an article will be produced meeting all the requirements, viz., the exclusion of water, the preservation of the softness of the leather, and the susceptibility of the compound to receive a high polish.

To make this preparation take of alcohol (ninety-four per cent.) one gallon; Venice terebinthina, one pound; gum-shellac, one pound; glycerine, one pound; myrtle-wax, one-fourth pound, and of fine lamp or ivory-black, enough to give the requisite color and consistency.

Digest the gum in the alcohol until thoroughly dissolved. A portion of the glycerine is used in grinding the myrtle-wax, and a portion in grinding the blacking, so as to make it perfectly soluble in the alcohol. The ingredients, after being mixed, must be stirred until a perfect union is effected. The composition is to be applied to the leather with a brush or sponge, in the usual manner.

Castor oil may be used with the glycerine resin, for carriage-tops and other work where a brilliant polish is not required.

Composition for Polishing, Water-proofing, and Coloring Leather.

In making this composition, which is the invention of Martyn, proceed as follows: To one imperial gallon of water add three ounces of nut-galls, and heat the water and maintain it at a simmering temperature for about half an hour, so as to thoroughly extract the tannin from the galls. Next remove the liquid from the galls, and raise it to a boiling heat, and while at this

boiling temperature introduce two ounces of strong spirits of ammonia, borax, or other suitable alkali, and one and one-half pounds of gum-shellac, and stir the whole until thorough solution of the shellac takes place. Next add to the solution one drachm of aniline color in crystal, using generally "aniline-blue," or violet, or both, or an aniline-black, for instance. Next add to the solution three ounces of vegetable, ivory, or lampblack. After stirring until the latter addition is well incorporated, the composition will be complete and ready for use.

It is to be applied to the leather, boot, shoe, or other article by means of a brush or sponge, and when dry will be found to impart to it a brilliant enamel surface, one impervious to water. The proportions of the ingredients may be varied somewhat, more or less, without materially changing the character of the process.

The vegetable, ivory, or lampblack will, by the gum, be held in suspension in the liquid, but the compound should be thoroughly stirred every time before using.

Polish for Leather used for Bags, Satchels, etc.

This polish, patented by Eddlemon and Walker, is in the nature of a blacking, and to prepare it mix the following ingredients in the proportions stated, viz: 1 quart alcohol, 4½ ounces gum shellac, 3 ounces English rosin, 1 ounce oil of sassafras, 1 ounce castor oil, 1 ounce lampblack, and ¾ of an ounce beeswax. These ingredients are placed in a tin vessel over a slow fire, stirring frequently until the shellac, rosin, and beeswax are dissolved, and the whole mixed thoroughly, which will require from twenty to thirty minutes. It is then removed from the fire, and, after cooling off, is ready for use.

This polish may be used for bags, satchels, harness, boots, shoes, and all other leather goods, as it will not rub off, but gives it a fine and lasting gloss, besides softening the leather and rendering it water-proof by filling the pores. It may be applied with a brush or soft rag (a piece of flannel is the best), or a sponge may be used, if desired. Several of the ingredients named have been used before separately or in different combi-

nations in the manufacture of leather-polish, notably the combinations of alcohol, gum-shellac, rosin, and lampblack, or other coloring matter, and these combinations are not claimed in this patent; but only those ingredients in the proportions above set out.

Coloring partially tanned Hides and Skins by the employment of a Bath of Tin, Acid and Water, and Turmeric.

In carrying out this process, which is that of Woodbury, submit the skin or hide, after its outer and inner layers have been tanned sufficiently, to the action of a bath composed of a solution of nitrate or muriate of tin, or nitrate or muriate of tin and a coloring matter, such as turmeric, for instance. In this bath allow the skin or hide to remain from twelve to twenty-four hours or thereabout, when it will be found, after removing the skin from the bath and washing it, that the tannin in the outer layers, or much of it, will have been thoroughly driven or forced into the inner layer, and a uniform or practically uniform tanning of the whole skin or hide will have taken place; also, that the tannin or coloring matter will have penetrated the entire skin so as to color or modify the color of it, as may be desirable. In preparing the bath of nitrate or muriate of tin take for each gallon of nitric or muriatic acid about one pound of the metal tin. The acid is to be poured upon the tin, or the latter is to be immersed in the acid, and the two are to be allowed to stand until the tin may have been dissolved or destroyed by the acid, after which there may be added to the solution the necessary amount of water, say about 140 gallons, and the turmeric or coloring matter.

Compound for changing the color of Leather, especially the color of the soles of Boots and Shoes.

This process, patented by May, relates to a compound to be applied to leather in the manufacture of boots and shoes, and for leather used for other purposes, for changing the color of the leather, designed more especially for changing the color of the soles or bottoms of boots and shoes, but not confined thereto; and it consists in the following compound: Take 2 gallons rye-

flour paste; 2 gallons tragacanth paste; 1 pound American isinglass; $1\frac{1}{4}$ pound oxalic acid; $\frac{1}{4}$ pound gum gamboge; 3 pounds pipe-clay, united with water sufficient to make 10 gallons of the compound of the proper consistency for use.

The mode of preparation is substantially as follows: While the rye paste (made in the usual way) is hot, add the isinglass and stir until all is dissolved; then add the tragacanth paste; then let the mass cool, and, when cold, add the oxalic acid, gum gamboge, and pipe-clay and water. Let the composition stand for the space of a week or so before using.

This composition fills the pores and makes the leather bright and hard. By the use of a revolving brush, or of friction applied otherwise after the application of the composition, the complexion or color of the leather may be changed, as desired. The bottom of a boot or shoe or other leather may be made of a very light color, or of a dark red or other complexion or shade. The color, it is claimed, will not fade, and the application of the compound, it is also claimed, improves the wear or durability of the leather.

Compound for Whitening Leather.

Tinnerholm's process for whitening leather is as follows: He takes—

Acid, tartar., crys.	2 ounces
Acid, muriatic, crys.	2 "
Cream tartar	2 "
Sulphur	2 "
Water	20 gallons

The above ingredients are mixed and placed in the vats with the hides, and in it they remain for two hours.

List of all Patents for Compounds for Coloring and Polishing Leather, issued by the Government of the United States of America, from 1790 *to* 1883 *inclusive.*

No.	Date.	Inventor.	Residence.
5,327	Oct. 9, 1847.	W. McAdams,	Albany, N. Y.
33,331	Sept. 24, 1861.	J. Brainerd,	Cleveland, Ohio.
46,804	Mar. 14, 1865.	X. Karcheski,	Bellville, N. J.
62,120	Feb. 19, 1867.	S. Dyar,	Charlestown, Mass.
77,021	Apr. 21, 1868.	T. M. Farnham,	Tully, N. Y.
118,089	Aug. 15, 1871.	D. Woodbury,	Peabody, Mass.
121,375	Nov. 13, 1871.	G. Jäger,	Indianapolis, Ind.
124,965	Mar. 26, 1872.	T. C. May,	Cochituate, Mass.
130,958	Aug. 27, 1872.	G. W. Walker,	Lowell, Mass.
142,797	Mar. 29, 1873.	J. Koppitz and	Boston, Mass.
		F. B. Mayer,	Cambridgeport, Mass.
147,337	Feb. 10, 1874.	H. Martyn,	Martha's Vineyard, Mass.
158,608	Jan. 12, 1875.	C. J. Tinnerholm,	Keokuk, Ia.
164,678	June 22, 1875.	E. H. Fennessy,	Newton, Mass.
165,129	June 29, 1875.	H. Smith,	Newark, N. J.
167,183	Aug. 31, 1875.	H. Martyn,	Boston, Mass.
170,100	Nov. 16, 1875.	H. W. Merrill and	Lynn, Mass.
		J. W. Hoitt,	
171,787	Jan. 4, 1876.	Otto Fiorillo,	Baltimore, Md.
179,560	July 4, 1876.	A. S. Humphrey,	Poughkeepsie, N. Y.
190,660	May 8, 1877.	Geo. S. Wolff,	Philadelphia, Pa.
194,754	Aug. 28, 1877.	Geo. S. Wolff,	Philadelphia, Pa.
203,498	May 7, 1878.	N. Quinlan and	Glens Falls, N. Y.
		J. H. Quinlan,	
225,772	Mar. 23, 1880.	M. B. Tice,	Newark, N. J.
243,000	June 14, 1881.	N. G. Sörensen,	Stockholm, Sweden.
265,041	Sept. 26, 1882.	J. F. Eddlemon, and	Witcherville, Ark.
		W. L. Walker,	

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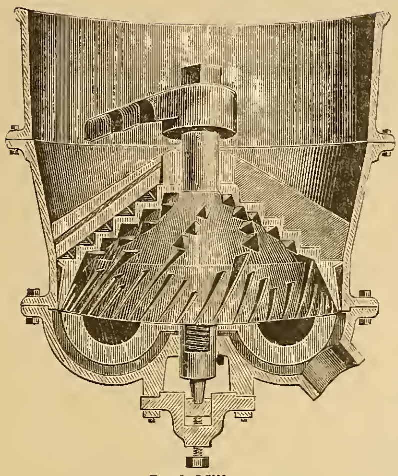

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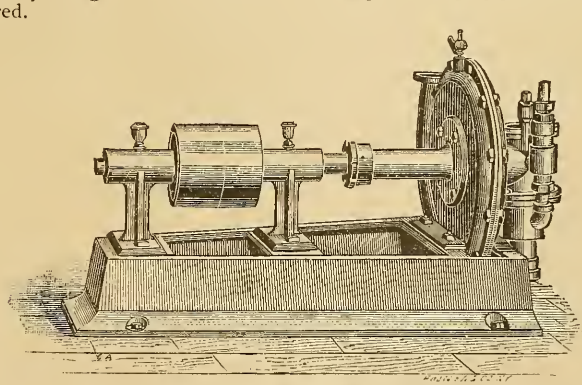

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